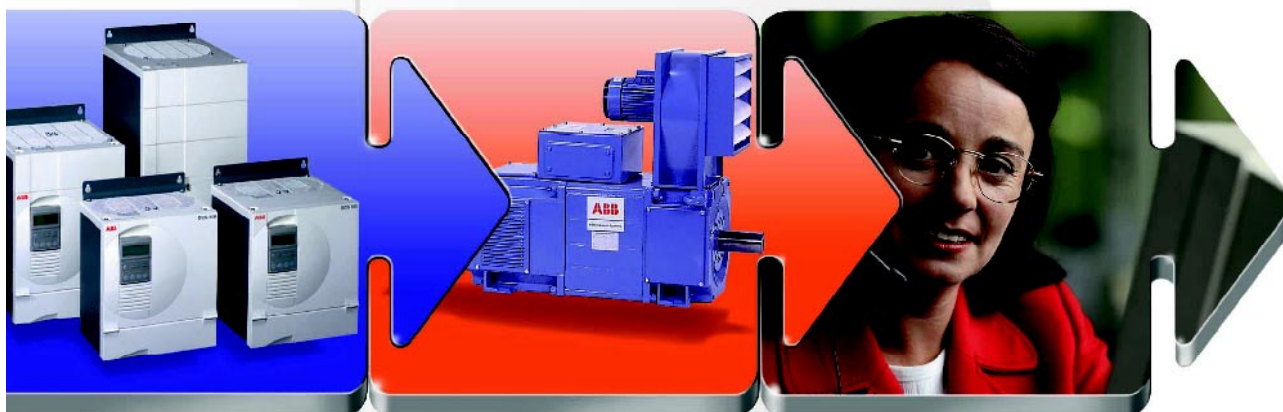


DCS Thyristor Power Converters

for DC drive systems
20 to 1000 A

Service Manual

DCS 400



ABB

Thyristor Power Converters

Series
DCS 400

Service Manual

Code: 3ADW 000 131 R0101 Rev A

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EFFECTIVE:	May 17th, 2001
SUPERSEDES:	none

Overview

This chapter contains safety instructions that must be complied with during installation, operation and maintenance of the power converter series **DCS 400**. If these instructions are not complied with, this may result in injuries (perhaps even with fatal consequences) or in damage to the power converter, the motor and the driven machine. Before starting with any work whatsoever at or with this unit, you must read the information given in this chapter.

Warnings

Warnings provide information on states, which if the specified procedure for the state concerned is not meticulously complied with may result in a serious error, in major damage to the unit, in injury to persons, and even in death.

They are identified by the following symbols:



Danger: High Voltage! This symbol warns you of high voltages, which may result in injuries to persons and/or damage to equipment. Where appropriate, the text printed adjacent to this symbol describes how risks of this kind may be avoided.

- All electrical installation and maintenance work on the thyristor power converter must be carried out by properly qualified staff who has been thoroughly trained in electrical engineering.
- The thyristor power converter and its adjacent units must be properly earthed by qualified professionals.
- You must NEVER perform any work on the thyristor power converter while it is still switched on. First switch the unit off, use a measuring instrument to make absolutely sure that the power converter has really been de-energised, and only then you may start with the work concerned.
- Due to external control circuits, there may be dangerously high voltages present at the thyristor power converter even after the line voltage has been switched off. So always work at the unit with appropriate caution! Non-compliance with these instructions may result in injury (or even death!).



General warning: this symbol warns you of non-electrical risks and dangers, which may result in serious or even fatal injury to persons, and/or in damage to equipment. Where appropriate, the text printed adjacent to this symbol describes how risks of this kind may be avoided.

- When thyristor power converters are in use, the electric motors, power transmission elements and the driven machines are working in an extended operating range, which means they have to cope with a relatively high loading.
- You should have made sure that all units, devices and appliances used are actually suitable for this higher loading.
- If you have to operate the thyristor power converter at a rated motor voltage and/or a rated motor current significantly below the figures stated in the thyristor power converter's output data, you must take appropriate precautionary measures to protect the unit against overspeed, overload, breakage, etc., by modifying the software or hardware appropriately.
- For insulation testing, you must disconnect all cables from the thyristor power converter. You should avoid operating your unit at values other than the rated data. Non-compliance with these instructions may cause lasting damage to the thyristor power converter.
- The thyristor power converter possesses a number of automatic reset functions. When these functions are executed, the unit will be reset after an error and will then resume operation. These functions should not be used if other units and devices are not suitable for an operating mode of this kind, or if their use might entail dangerous situations.



Warning of electrostatic discharge: this symbol warns you against electrostatic discharges, which may damage the unit. Where appropriate, the text printed next to this symbol describes how a risk of this kind may be avoided.

Notes

Notes supply information on states requiring particular attention, or indicate that additional information is available on a specific topic. For this purpose, the following symbols are used:

CAUTION! **Cautions** are designed to draw your attention to a particular state of affairs.

Note A **note** contains or refers you to additional information available on the particular topic concerned.

Mains connection

You can use a switch disconnecter (with fuses) in the power supply of the thyristor power converter to disconnect the electrical components of the unit from the power supply for installation and maintenance work. The type of disconnecter used must be a switch disconnecter as per EN 60947-3, Class B, so as to comply with EU regulations, or a circuit-breaker type which switches off the load circuit by means of an auxiliary contact causing the breaker's main contacts to open. The mains disconnecter must be locked in its "OPEN" position during any installation and maintenance work.

EMERGENCY STOP buttons

EMERGENCY STOP buttons must be installed at each control desk and at all other control panels requiring an emergency stop function. Pressing the STOP button on the DCS400-PAN control panel of the thyristor power converter will neither cause an emergency motor stop, nor will the drive be disconnected from any dangerous potential.

Intended use

The operating instructions cannot take into consideration every possible case of configuration, operation or maintenance. Thus, they mainly give such advice only, which is required by qualified personnel for normal operation of the machines and devices in industrial installations.

If in special cases the electrical machines and devices are intended for use in non-industrial installations - which may require stricter safety regulations (e.g. protection against contact by children or similar) -, these additional safety measures for the installation must be provided by the customer during assembly.

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Chapter 1 - Introduction

How to use this manual

The purpose of this service manual is to provide detailed information on how to exchange thyristors and **Printed Circuit Boards (PCB)** installed in power converters from the **DCS 400** series.

Contents of this manual

Chapter 1 - Introduction

This chapter informs about the contents and the use of this manual as well as about the boundary conditions applying.

Chapter 2 - Dismounting the converter

This chapter describes how to dismount the converter.

Chapter 3 - Controller board SDCS-CON-3(A)

This chapter describes how to test the controller board and the burden adaptation.

Chapter 4 - Power interface board SDCS-PIN-3(A)

This chapter describes specialities of the power interface board.

Chapter 5 - Field Exciter Unit SDCS-FIS-3(A)

This chapter describes the exchange of field exciter unit mounted in converter.

Chapter 6 - Thyristor modules

This chapter describes the fault tracing, handling and exchanging of thyristor modules for frame sizes A1...A4 as well as some special data (firing pulses, temperature of thyristor bridge, I_T values and so on).

Chapter 7 - Preventive Maintenance

This chapter describes the measures for preventive maintenance of the thyristor converters.

Appendix A - Spare Parts list

The appendix A contains the spare parts list of the converters.

Appendix B- Circuit diagrams

The appendix B shows specific circuit diagrams.

Appendix C- Compatibility of Hardware / Software

This appendix describes the permissible configurations depending on the different hard- and software possibilities. Furthermore the procedures for updating the Drive's firmware is shown.

Target group

This manual is designed to help those responsible for planning, installing, starting up and servicing the thyristor power converter.

These people should possess

- basic knowledge of physics and electrical engineering, electrical wiring principles, components and symbols used in electrical engineering, and
- basic experience with DC drives and products.

Associated publications

The *Manual DCS 400* (publication no. 3ADW 000 095) includes the following:
System overview
Technical data
Overview of software
Installation
Operating instructions
Serial interfaces

Storage and transport


If the unit had been in storage prior to installation or is transported to another location, care must be taken to ensure that the environmental conditions are complied with (see *Manual DCS 400*).

CAUTION! The thyristor power converter weighs quite a lot and should therefore not be held by the front cover. Please put the unit down only on its back. Always use due care when handling the unit, so as to avoid injuries or damage.

Rating plate

For purposes of identification, each thyristor power converter is fitted with a rating plate, stating the type code and the serial number, which serve as individual identification of each unit.
The type code contains information on the characteristics and the configuration of the unit.

Example

ABB Automation Products GmbH	Made in Germany	Fan	115 / 230 V
Type: DCS402.0050 REV.A.1	U ₁	3~230...500 V	U ₂ 240...520 V _{DC}
Ser No: 7042176 A049 1234	I ₁	41 A	I ₂ 50 A
	f ₁	50 / 60 Hz	IF 6 A

Type	DCS402.0050 REV.A.1 DCS402. 0050	rating plate 4-Q converter nominal DC current in Amps (50 A)
	DCS401.0230 REV.A.1 DCS401. 0230	rating plate 2-Q converter nominal DC current in Amps (230 A)
	REV.A.1	Revision status A : <ul style="list-style-type: none">- new PCB's SDCS-CON-3A, SDCS-PIN-3A , SDCS-FIS-3A- improved analogue I/O resolution 12 bit- new internal field choke- increased field current rating 4/6/16/20 A- increased field voltage range 50...440 V

		No Revision status: - depending on SDCS-CON-3(A): Analogue resolution 10 / 8 (12) Bit - independent on used PCB's: Field current rating 6 / 16 / 16 A Field voltage range 50...350 V
Ser No	7042176 A 0 49 1234 7042176 A 0 49 1234	Serial no. Manufacturing number for identification Index Year of production (double character up to Oct. 99, af- terwards single character) week of production current number
Fan	115 / 230 V	Fan supply 115 V _{AC} or 230 V _{AC} DCS401.0020 / DCS402.0025 with- out fan
U₁	3~230...500 V	Mains supply 230 V _{AC} to 500 V _{AC} , 3-phase
U₂	240...520 V_{DC}	Converter nominal DC voltage 240 V to 520 V (U ₂ = 240 V at U ₁ = 230 V) (U ₂ = 520 V at U ₁ = 500 V)
I₁	41 A	Converter nominal AC current 41 A
I₂	50 A	Converter nominal DC current 50 A
f₁	50 / 60 Hz	Frequency 50 Hz or 60 Hz
I_F	6 A	Field current nominal 6 A

The technical data and specifications are valid as of going to press.
 ABB reserves the right to make subsequent alterations.

If you have any questions concerning your drive system, please
 contact your local ABB agent.

Chapter 2 - Dismounting the Converter



Before you start work, disconnect the converter completely from the power supply then check the voltage free condition and make sure, everything is located in an electrically and mechanically safe condition!

Main components of DCS400 module

The main components of DCS 400 (4-Q units) are shown in the figures below.

Frame size A1

- 1 Lid
- 2 Cover
- 3 PCB Panel adapter
- 4 PCB SDCS-CON-3(A)
- 5 Base plate of electronic
- 6 MP capacitor
- 7 PCB SDCS-PIN-3(A)
- 8 InsulationPlate
- 9 Spacer stud
- 10 Current transformer
- 11 Busbars
- 12 Terminal sensor
- 13 Choke
- 14 PCB SDCS-FIS-3(A)
- 15 Thyristor modul
- 16 Distanz nut
- 17 Terminal block
- 18 Heatsink
- 19 Housing
- 20 Fan
- 21 Top plate
- 22 Fan terminal
- 23 Screws

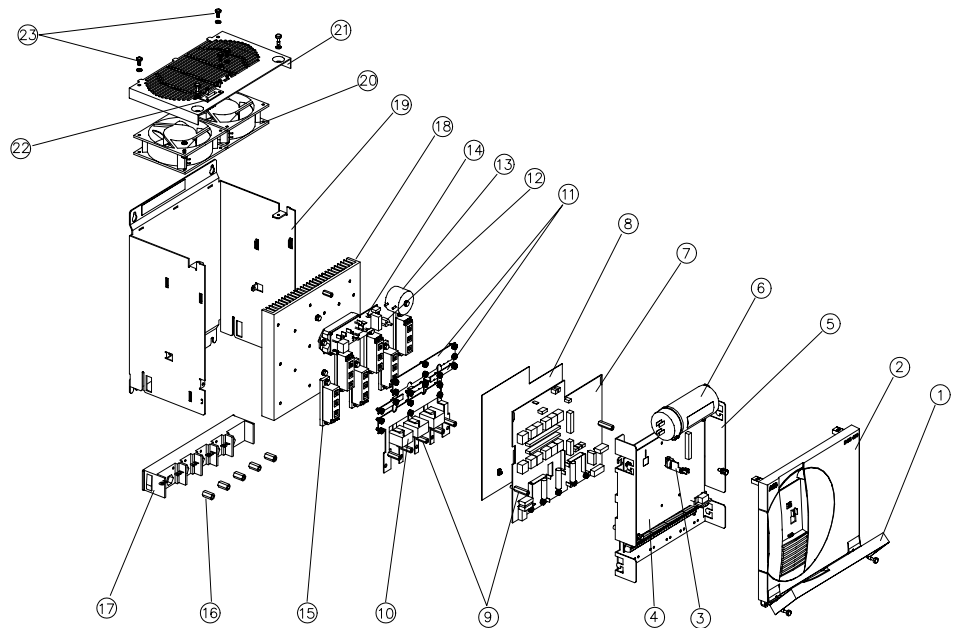


Fig. 2-1 3-D drawing of the DCS 400 Frame size A1

Frame size A2

- 1 Lid
- 2 Cover
- 3 PCB Panel adapter
- 4 PCB SDCS-CON-3(A)
- 5 MP capacitor
- 6 PCB SDCS-PIN-3(A)
- 7 Current transformer
- 8 Thyristor modul
- 9 Choke
- 10 Thermal sensor
- 11 PCB SDCS-FIS-3(A)
- 12 Housing
- 13 Fan
- 14 Fan terminal
- 15 Top plate
- 16 Base plate of electronic
- 17 Spacer stud
- 18 Busbars
- 19 Heatsink
- 20 Terminal block
- 21 Screws

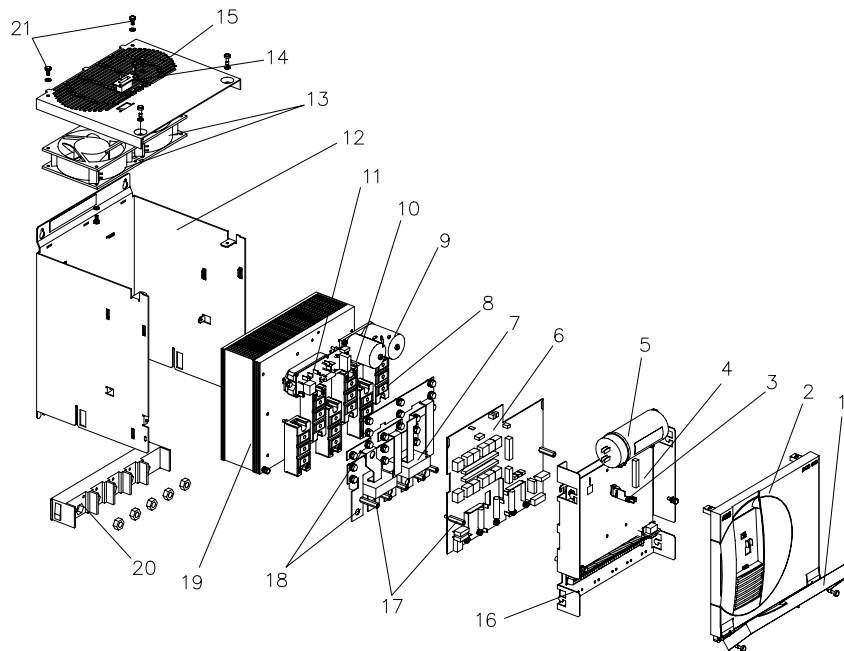


Fig. 2-2 3-D drawing of the DCS 400 Frame size A2

Frame size A3

- 1 Lid
- 2 Cover
- 3 Edional Cover
- 4 Base plate of electronic
- 5 MP capacitor
- 6 PCB SDCS-CON-3(A)
- 7 PCB Panel adapter
- 8 Spacer stud
- 9 PCB SDCS-PIN-3(A)
- 10 Current transformer
- 11 Busbars
- 12 Distanz nut
- 13 Terminal block
- 14 Choke
- 15 Terminal sensor
- 16 PCB SDCS-FIS-3(A)
- 17 Thyristor modul
- 18 Heatsink
- 19 Housing
- 20 Fan
- 21 Fan terminal
- 22 Top plate

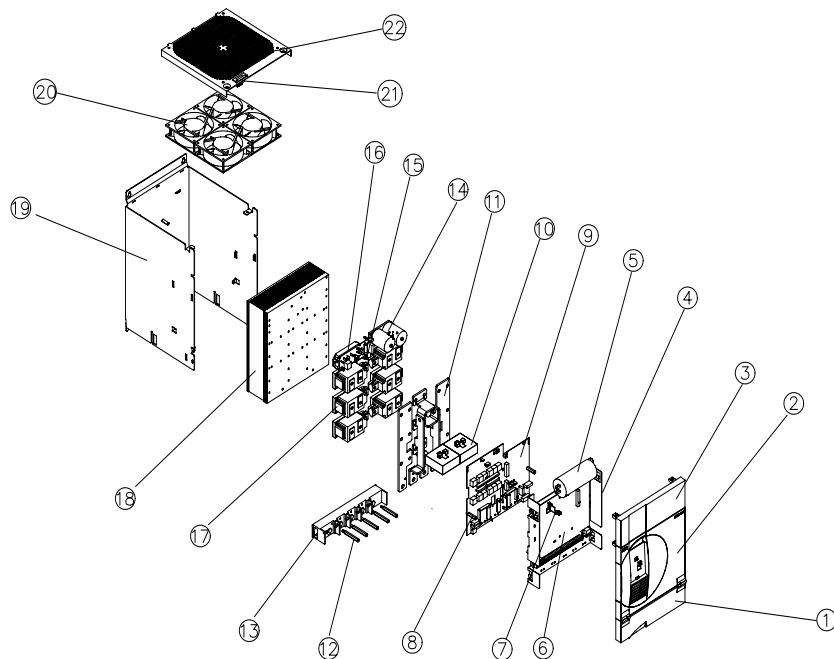


Fig. 2-3 3-D drawing of the DCS 400 Frame size A3

Frame size A4

- 1 Lid
- 2 Cover
- 3 Edional Cover
- 4 Base plate of electronic
- 5 MP capacitor
- 6 PCB SDCS-CON-3(A)
- 7 PCB Panel adapter
- 8 Spacer stud
- 9 PCB SDCS-PIN-3(A)
- 10 Current transformer
- 11 Busbars
- 12 Distanz nut
- 13 Heatsink
- 14 Choke
- 15 Terminal sensor
- 16 PCB SDCS-FIS-3(A)
- 17 Thyristor modul
- 18 Heatsink
- 19 Housing
- 20 Fan
- 21 Fan terminal
- 22 Top plate

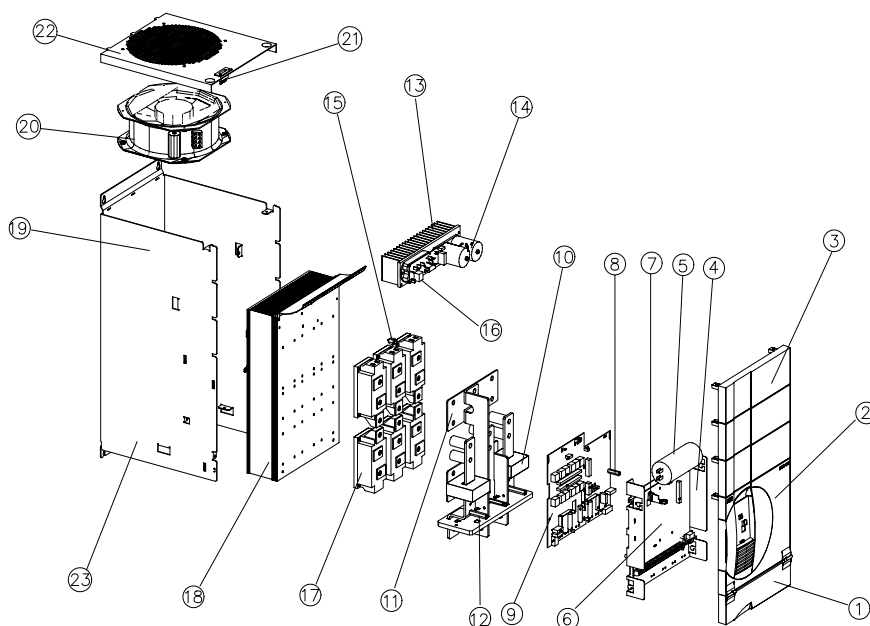


Fig. 2-4 3-D drawing of the DCS 400 Frame size A4

Open the converter

- Remove the panel DCS400PAN.
- Loose (not remove) the screws at the top of the converter and behind the flap.
- Remove the top cover plate incl. fan.
- Remove the front cover.

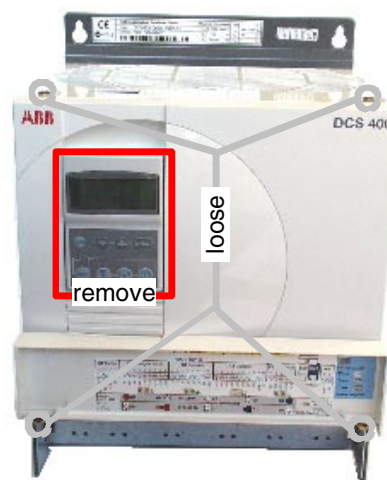


Fig. 2-5 Open the converter

Controller frame in maintenance position

For test purposes the controller frame can be set in a maintenance position.

Danger:



Remove controller frame:

- Loose (don't remove) fixing screws of controller frame.
- Lift **up** the frame approx. 1 cm and take it out to the front.

Safety instructions must be followed

- When working on live drive converters, the applicable national accident prevention (e.g. VBG 4) must be complied with.
- When switched on high voltage is applied to the DC link capacitor.

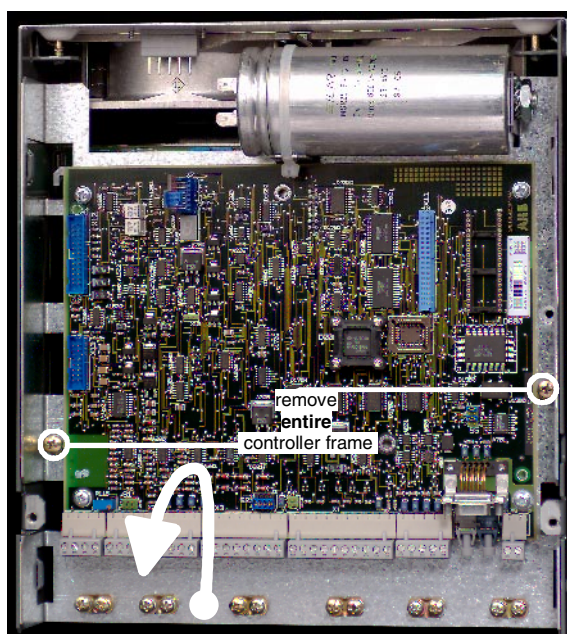


Fig. 2-6 Removing the Controller board for fixing in maintenance position

Attach controller frame in maintenance position:

- Fix clamp of the mounting plate (upper left) to eye in the housing (upper right).
- Establish ground potential between housing and mounting plate.

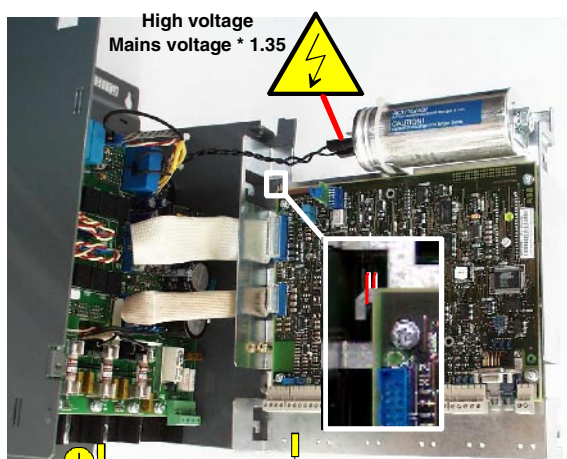


Fig. 2-7 Controller board in maintenance position

Remove controller board SDCS-CON-3(A)

- Remove flat cable connectors X12 / X13.
- Remove panel adapter PCB at X7.
- Remove I / O terminal plugs X1...X8.
- If necessary remove optical cable at V800.
- Remove fixing screws of controller board.

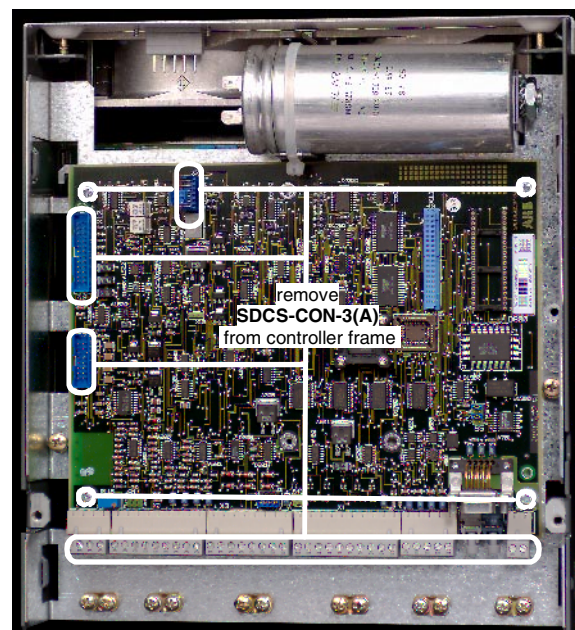


Fig. 2-8 Removing Controller board

Remove the entire controller frame

- Remove flat cable connectors X12 / X13.
- Remove plugs at the DC link capacitor.
- Loose (don't remove) fixing screws of controller frame.
- Remove I / O terminal plugs X1...X8.
- If necessary remove optical cable at V800.
- Lift **up** the frame around 1 cm and take it out to the front.

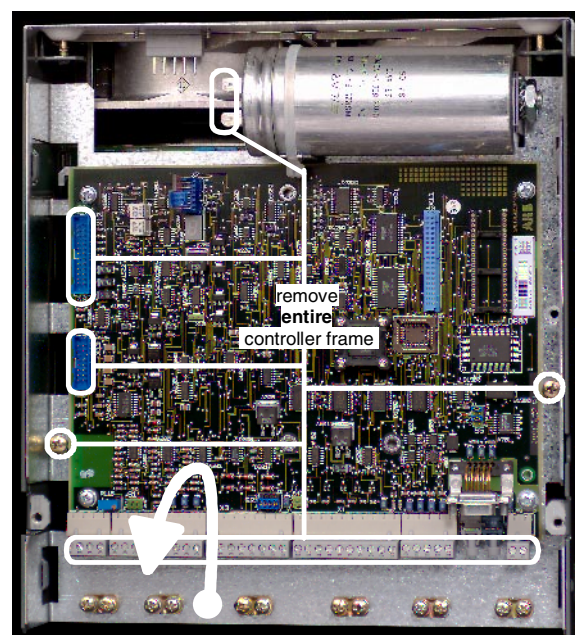


Fig. 2-9 Remove Controller frame

Remove power interface board SDCS-PIN-3(A)

- Pay attention to the wire at terminal **X100**: Please remember the **number of windings** through current transformer **T2** !

Module size

A1 ⇒ **three**

A2 ... A4 ⇒ **one**

- Disconnect all the electrical plugs.
- Remove all fixing screws and bolts.
- Pull board downward about 5 cm from clutch and remove straight forward.

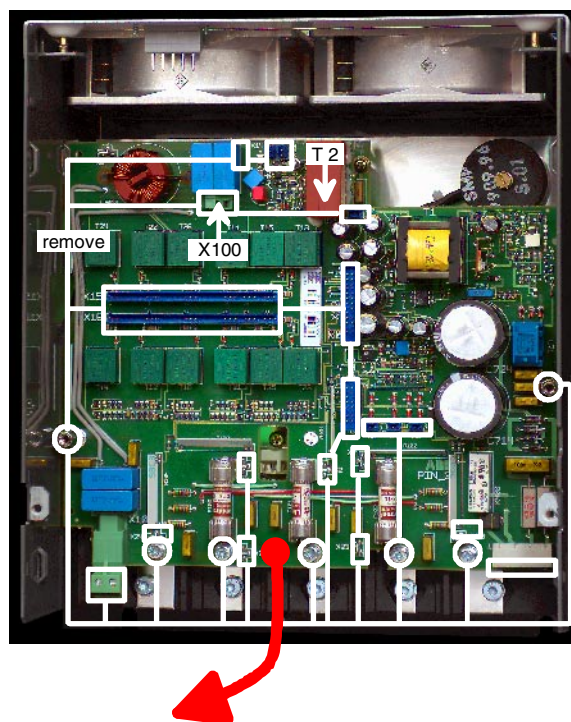


Fig. 2-10 Remove PIN board

Remove field exciter SDCS-FIS-3(A)

Caution!

After power down please wait at least 30 s for discharging the capacitor!

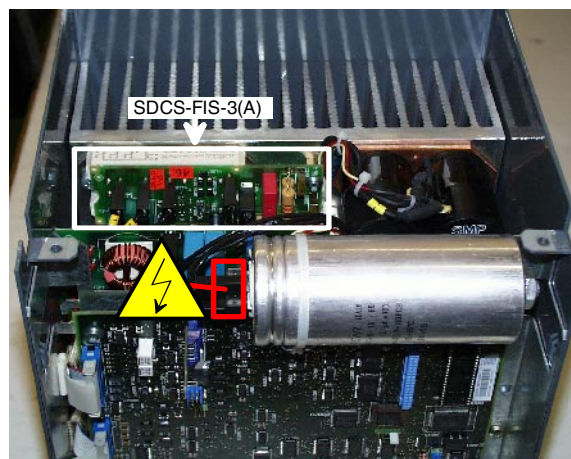


Fig. 2-11 Field exciter location

- Disconnect all the electrical plugs.
- Remove all fixing screws.
- Do not forget to add thermal joint compound when exchanging.

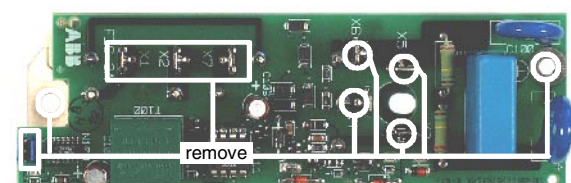


Fig. 2-12 Remove field exciter

Chapter 3 - Controller board SDCS-CON-3(A)

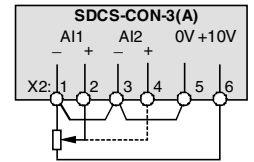
Short test of inputs / outputs

Precondition for the short tests is to switch on the electronics supply voltage.

Analogue Inputs

AI1:

- Connect a potentiometer to **AI1**.
- Select parameter **AI1 Act (6.26)** at the operating panel.
- Changes of the potentiometer are displayed at the panel.



AI2:

- Connect a potentiometer to **AI2**.
- Select parameter **AI2 Act (6.27)** at the operating panel.
- Changes of the potentiometer are displayed at the panel.

Analogue Outputs

AO1:

- Connect a potentiometer to **AI1** or **AI2**.
- Set parameter **AO1 Assign (6.05)** to **AI1 Act** or **AI2 Act**.
- Connect a voltmeter to terminal **X2:8 (+)** and **X2:5 (0V)**.
- Changes of the potentiometer are shown at the voltmeter.

AO2:

- Connect a potentiometer to **AI1** or **AI2**.
- Set parameter **AO2 Assign (6.08)** to **AI1 Act** or **AI2 Act**.
- Connect a voltmeter to terminal **X2:9 (+)** and **X2:5 (0V)**.
- Changes of the potentiometer are shown at the voltmeter.

Set back parameter **AOx Assign (6.0x)** to the original value.

Digital Inputs

- Select parameter **DI Act (6.28)** at the operating panel.
- Switch **off** all digital inputs.
- In case of faults or alarms press **ENTER** button.

State of digital inputs must be displayed as **0000HEX**.

Switch on **DI1** 1 panel display = **0001HEX**, switch off **DI1**.

Switch on **DI2** 1 panel display = **0002HEX**, switch off **DI2**.

Switch on **DI3** 1 panel display = **0004HEX**, switch off **DI3**.

Switch on **DI4** 1 panel display = **0008HEX**, switch off **DI4**.

Switch on **DI5** 1 panel display = **0010HEX**, switch off **DI5**.

Switch on **DI6** 1 panel display = **0020HEX**, switch off **DI6**.

Switch on **DI7** 1 panel display = **0040HEX**, switch off **DI7**.

Switch on **DI8** 1 panel display = **0080HEX**, switch off **DI8**.

Digital Outputs

<p>Disconnect terminal at the desired digital output:</p> <p>DO1 = X5:1 or DO2 = X5:2 or DO3 = X5:3 or DO4 = X5:4 or DO5 = X98:1 + X98:2</p> <p>DO1...DO4:</p> <ul style="list-style-type: none"> • Connect a voltmeter to the desired terminal X5:1/2/3/4 and X5:5 (0V). • Set parameter DOx Assign (6.1x) to none. • Voltmeter \Rightarrow 0V. • Set parameter DOx Assign (6.1x) to constant 1. • Voltmeter \Rightarrow +24V. <p>DO5:</p> <ul style="list-style-type: none"> • Connect an ohmmeter to terminal X98:1 and X98:2. • Set parameter DO5 Assign (6.15) to none. • Ohmmeter \Rightarrow $\infty \Omega$. • Set parameter DO5 Assign (6.15) to constant 1. • Ohmmeter \Rightarrow 0 Ω. <p>Set back parameter DOx Assign (6.1x) to the original value</p>	
---	--

Supply Voltages

All of the supply voltages are measurable at the terminals. If a voltage is missing at the terminals it is also measurable at IC's at the controller board (be carefully).

	Terminals	Controller board SDCS-CON-3(A)
Voltage for reference potentiometer	X2:5 = 0V \Rightarrow X2:6 = +10V \Rightarrow X2:7 = -10V \Rightarrow	Frame IC A200: 8 IC A200:14
Encoder supply	X3:7 = 0V \Rightarrow X3:8 = +U depends on Jumper S2 S2:10-11 = +5V \Rightarrow S2:11-12 = +24V \Rightarrow	Frame Jumper S2:10 IC A300: heatsink
Digital Inputs (Digital Output circuits)	X4: 9 = +24V \Rightarrow X4:10 = 0V \Rightarrow	IC A501: heatsink Frame
Fieldbus Adapter	X8:1 = +24V \Rightarrow X8:2 = 0V \Rightarrow	IC A501: heatsink Frame

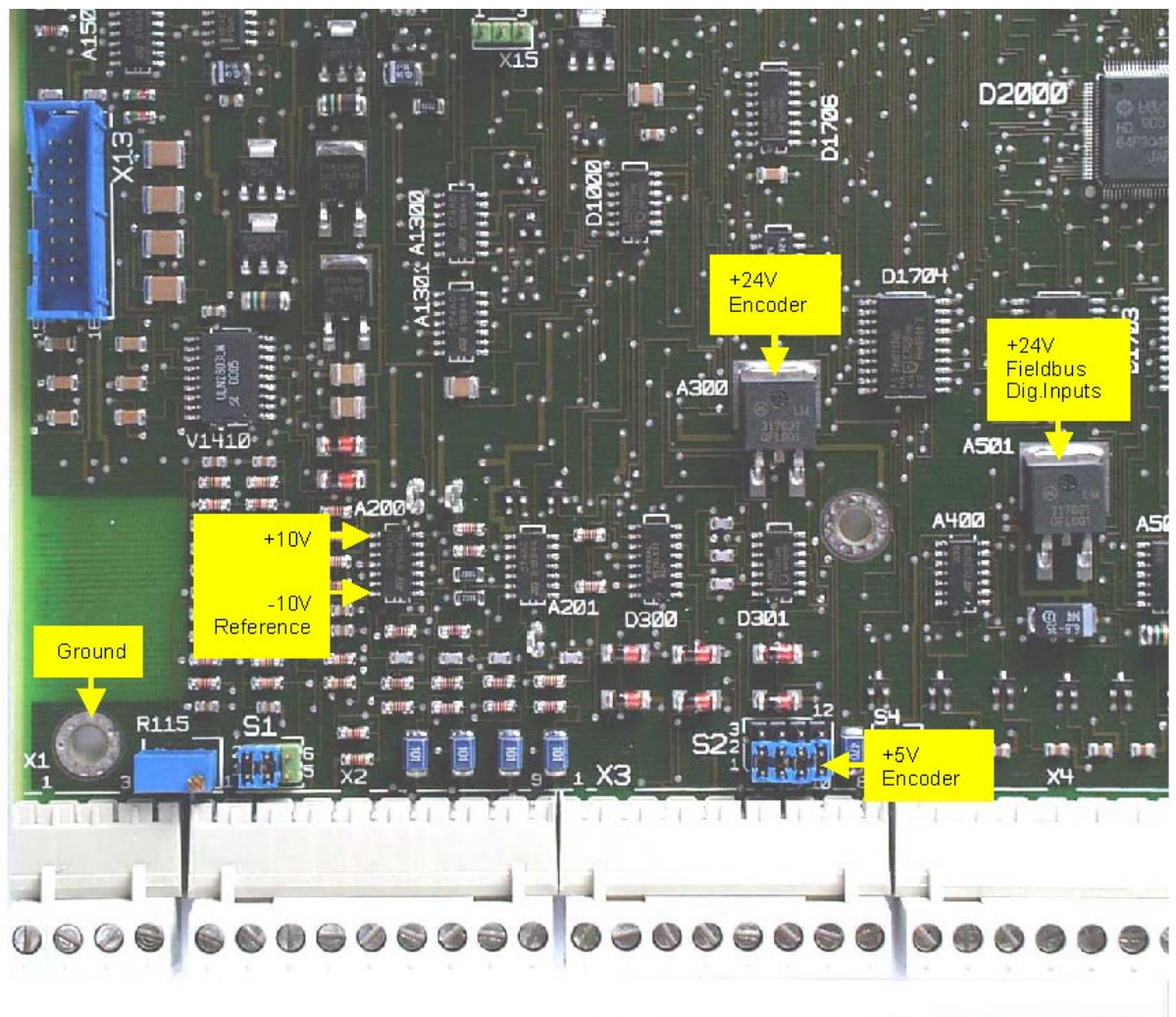


Fig. 3-1 Supply voltages on CON-3(A) board

Other helpful measuring points

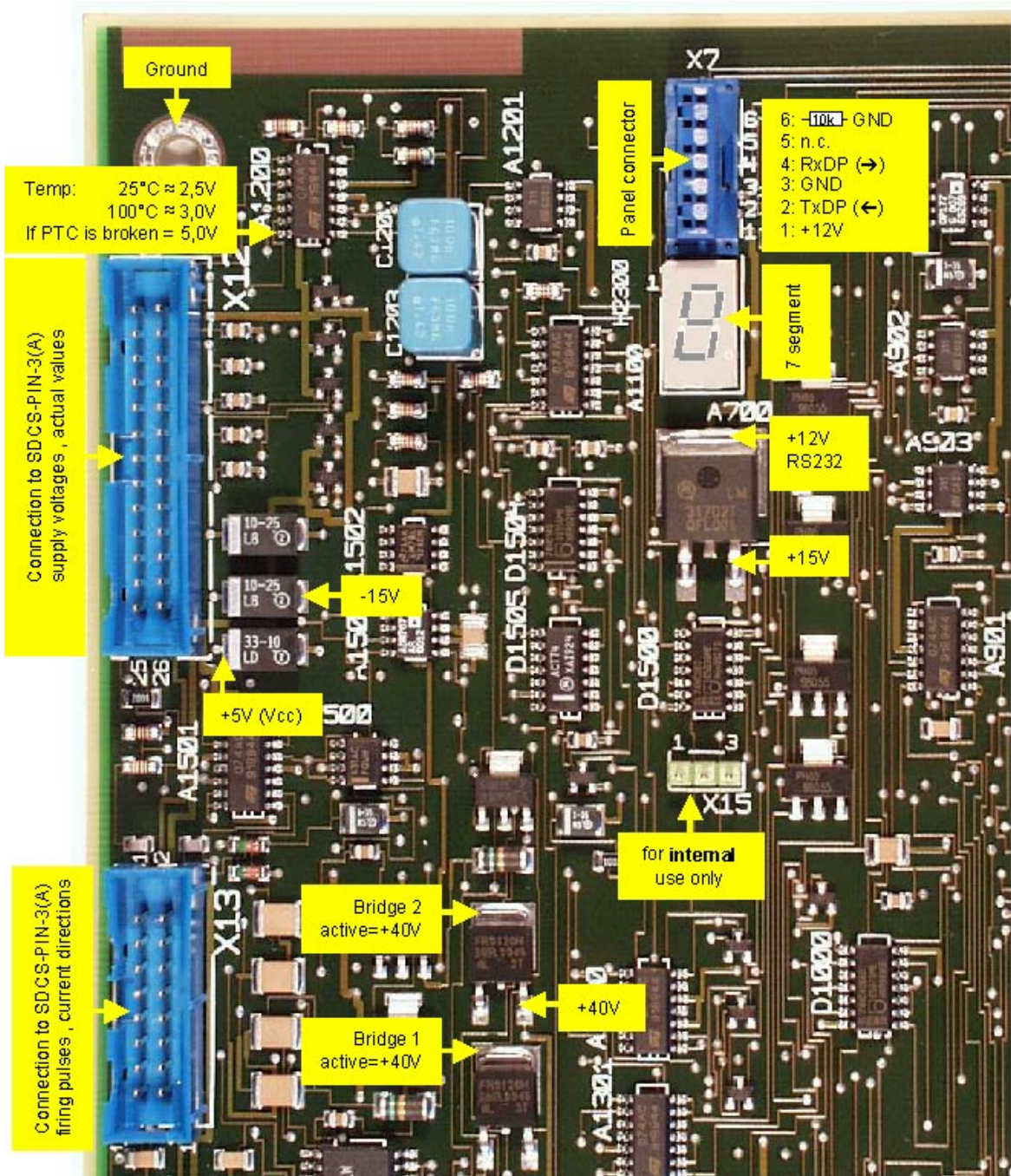


Fig. 3-2 Helpful measuring points on CON-3(A) board

Burden adaptation

DCS400 is equipped with a 16 step burden resistor adaptation controlled by software. Depending on actual armature current of the motor set in parameter **Arm Cur Nom (1.01)** the right burden resistor is switched on. It is necessary to increase the current transfer ratio when increasing motor current.

With the smallest step of 25 A and 16 steps a current up to 400 A could be handled by using a current transformer ratio of 1500:1. Currents greater than 400 A need a greater transformer ratio.

Used current transformer ratios:

25 A to 275 A	1500:1
276 A to 800 A	3000:1
801 A to 1200 A	4500:1

For that the possible current ranges are:

Transformer ratio	Current range
1500:1	25 A ... 400 A (in steps of 25 A)
3000:1	50 A ... 800 A (in steps of 50 A)
4500:1	75 A ... 1200 A (in steps of 75 A)

If armature current nominal set by parameter **Arm Cur Nom (1.01)** fits to the steps given by the switched steps then the **burden voltage** is **2 V**.

The switched burden resistors are:

120 Ω / 250 mW	$\pm 0,1 \%$
60 Ω / 250 mW	$\pm 0,1 \%$
30 Ω / 500 mW	$\pm 0,1 \%$
15 Ω / 1 W	$\pm 0,1 \%$

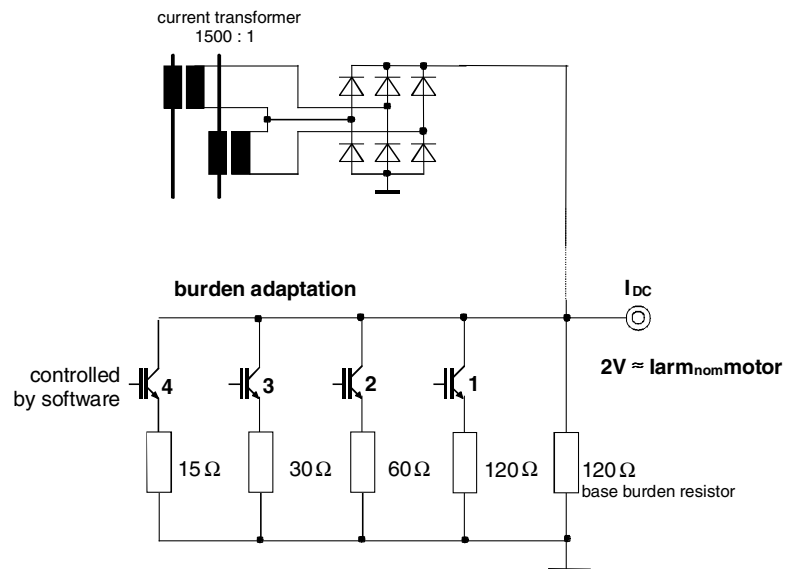

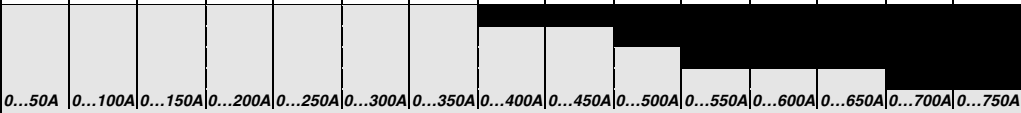


Fig. 3-3 Switched burden resistors

Overview burden adaptation per converter module


2-Q converters

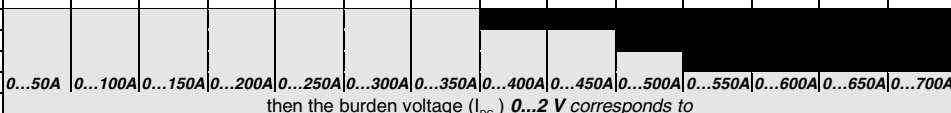
Current transformer	Size	if parameter Arm Cur Nom (1.01) is in a range:									
		from 4 A to 25 A	26 A to 50 A	51 A to 75 A	76 A to 100 A	101 A to 125 A	126 A to 150 A	151 A to 175 A	176 A to 200 A	201 A to 225 A	226 A to 250 A
DCS401. 0020	A1										
DCS401. 0045	A1										
DCS401. 0065	A1										
DCS401. 0090	A1										
DCS401. 0125	A1										
DCS401. 0180	A2										
DCS401. 0230	A2	0...25A	0...50A	0...75A	0...100A	0...125A	0...150A	0...175A	0...200A	0...225A	0...250A
then the burden voltage (I_{Nc}) 0...2 V corresponds to											

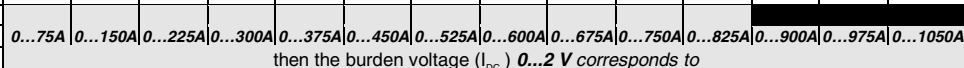
Current transformer	Size	if parameter Arm Cur Nom (1.01) is in a range:														
		from 4 A to 50 A	51 A to 100 A	101 A to 150 A	151 A to 200 A	201 A to 250 A	251 A to 300 A	301 A to 350 A	351 A to 400 A	401 A to 450 A	451 A to 500 A	501 A to 550 A	551 A to 600 A	601 A to 650 A	651 A to 700 A	701 A to 750 A
DCS401. 0315	A3															
DCS401. 0405	A3															
DCS401. 0500	A3															
DCS401. 0610	A4															
DCS401. 0740	A4	0...50A	0...100A	0...150A	0...200A	0...250A	0...300A	0...350A	0...400A	0...450A	0...500A	0...550A	0...600A	0...650A	0...700A	0...750A
then the burden voltage (I_{Nc}) 0...2 V corresponds to																

Current transformer	Size	if parameter Arm Cur Nom (1.01) is in a range:											
		from 4 A to 75 A	76 A to 150 A	151 A to 225 A	226 A to 300 A	301 A to 375 A	376 A to 450 A	451 A to 525 A	526 A to 600 A	601 A to 675 A	676 A to 750 A	751 A to 825 A	826 A to 900 A
DCS401. 0900	A4	0...75A	0...150A	0...225A	0...300A	0...375A	0...450A	0...525A	0...600A	0...675A	0...750A	0...825A	0...900A
then the burden voltage (I_{Nc}) 0...2 V corresponds to													

4-Q converters

		if parameter Arm Cur Nom (1.01) is in a range:										
Current transformer	Size	from 4 A to 25 A	26 A 50 A	51 A 75 A	76 A 100 A	101 A 125 A	126 A 150 A	151 A 175 A	176 A 200 A	201 A 225 A	226 A 250 A	221 A 275 A
DCS402. 0025	A1											
DCS402. 0050	A1											
DCS402. 0075	A1											
DCS402. 0100	A1											
DCS402. 0140	A1											
DCS402. 0200	A2											
DCS402. 0260	A2	0...25A	0...50A	0...75A	0...100A	0...125A	0...150A	0...175A	0...200A	0...225A	0...250A	0...275A
then the burden voltage (I_{Nc}) 0...2 V corresponds to												

		if parameter Arm Cur Nom (1.01) is in a range:													
Current transformer	Size	from 4 A to 50 A	51 A 100 A	101 A 150 A	151 A 200 A	201 A 250 A	251 A 300 A	301 A 350 A	351 A 400 A	401 A 450 A	451 A 500 A	501 A 550 A	551 A 600 A	601 A 650 A	651 A 700 A
DCS402. 0350	A3														
DCS402. 0450	A3														
DCS402. 0550	A3														
DCS402. 0680	A4														
then the burden voltage (I_{Nc}) 0...2 V corresponds to															

		if parameter Arm Cur Nom (1.01) is in a range:													
Current transformer 4500:1	Size	from 4 A to 75 A	76 A 150 A	151 A 225 A	226 A 300 A	301 A 375 A	376 A 450 A	451 A 525 A	526 A 600 A	601 A 675 A	676 A 750 A	751 A 825 A	826 A 900 A	901 A 975 A	976 A 1050 A
DCS402. 0820	A4														
DCS402. 1000	A4														
then the burden voltage (I_{Nc}) 0...2 V corresponds to															

Example

Burden voltage (0...2 V) depends on chosen burden resistor and parameter Arm Cur Nom (1.01).

e.g.

- Used converter should be **DCS401.0740**.
- Armature current **Arm Cur Nom (1.01)** should be 670 A.
- Armature current 670 A is in a range of 651...700 A, that means 0...700 A corresponds to 0...2 V burden voltage.
- 100% of actual armature current is 670 A , the corresponding burden voltage is $2 \text{ V} / 700 \text{ A} \times 670 \text{ A} = 1,91 \text{ V}$.

The burden circuitry is able to process values up to 4 V, therefore a maximum armature current of 200% is possible to represent.

Chapter 4 - Power interface board SDCS-PIN-3(A)

Power supply

The power supply of the DCS 400 series is a wide range input fly back converter. Regulation for the 5 V is done on the SDCS-PIN-3(A) board with the reference value coming from the controller board SDCS-CON-3(A). The output of the 5 V regulator is send to the primary side of the power supply via an opto-coupler. All voltages will follow the regulated 5 V supply depending on the load of each output.

The following voltages are available at **SDCS-PIN-3(A)** board:

+5V ; $\pm 0,1V$ / 0.5A	to supply the controller, the digital logic and an encoder
$\pm 15V$; $\pm 5\%$ / 0.1A	to supply the analogue integrated circuits
+24V ; $\pm 5\%$ / 0.4A	to supply the digital inputs / outputs, encoder and fieldbus adapter
+40V ; $\pm 5\%$ / 0.2A	to supply the firing pulse amplifiers

The voltages with there tolerances are designed to feed their nominal load.

With suppressed firing pulses for example the output of the +40 V will rise up to +50 V.

At the controller board **SDCS-CON-3(A)** there are some additional voltage regulators available:

Encoder:

+24V / 0.2A set by jumper, short circuit protected.

Reference:

$\pm 10V$; 0.01A generated from $\pm 15V$.

Panel:

+12V generated from +15V.

Fieldbus adapter, digital inputs / outputs:

+24V; 0.2A continuously / 0.6A for a short time, short circuit protected

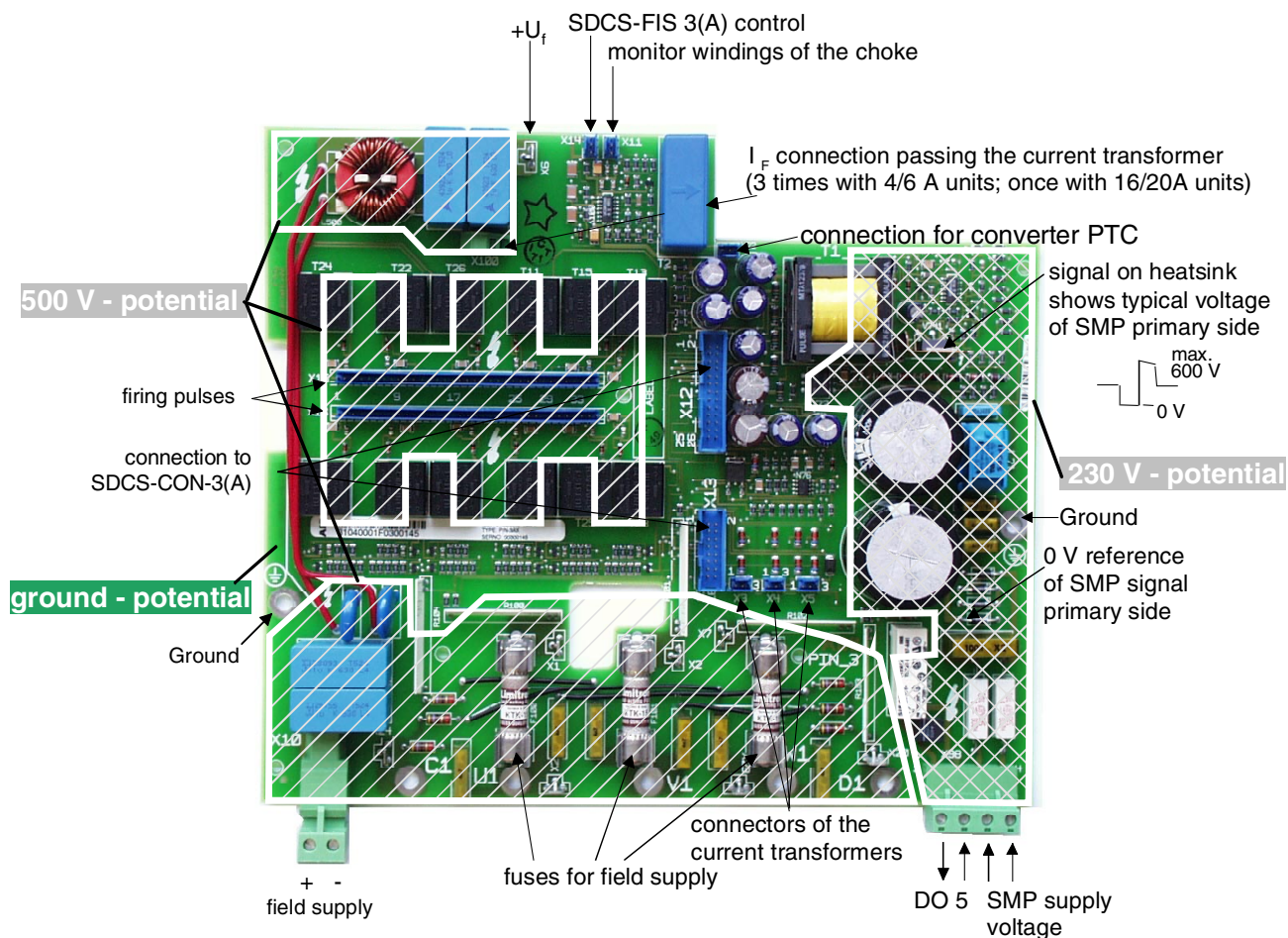


Fig. 4-1 SDCS-PIN-3(A)

Behavior of fault

If there is a short circuit at one or more outputs or the fly back converter will be overloaded, the power supply tries to start. If it is not successful it tries again in a few seconds interval.

This behaviour could be heard and be seen at the blinking seven-segment-display if the +5 V is not short-circuited. Nevertheless there are running modes of the power supply possible in case of a short circuit which will damage diodes at the secondary side of the fly back converter.

During running the power supply without controller board the voltages will rise to values outside the specified tolerances. These voltages are not very stable they will not endanger any parts of the power supply.

Field choke connection

SDCS-PIN-3

Old field choke (3ADT7480**69/70**) connected to X11:2 + X11:3.

SDCS-PIN-3AX

Temporary PCB (C503 / R512 manually mounted at the PCB).
Will be replaced by SDCS-PIN-3A.

New field choke (3ADT7480**73/74**)
connected to X11:1 + X11:3

SDCS-PIN-3A

Final PCB (C503 / R512 included in PCB layout).

New field choke (3ADT7480**73/74**)
connected to X11:1 + X11:3

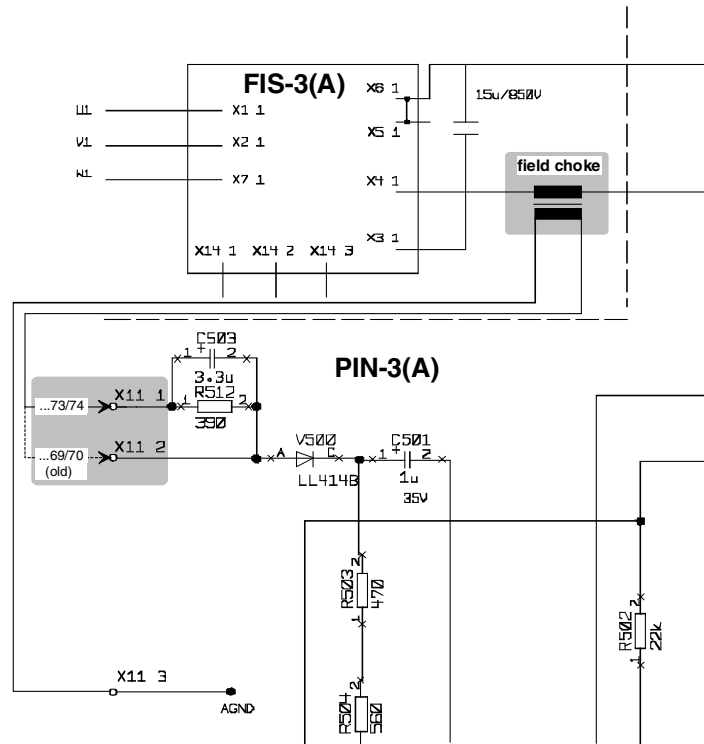


Fig. 4-2 Connection of old / new field choke

Chapter 5 –Field Exciter Unit SDCS-FIS-3(A)

Test of SDCS-FIS-3(A)

The test includes a check of the field voltage and field current operation. Previously some measures have to be taken.

Start conditions

- Drive software version **108.0 or higher**
- Parameter **Arm Volt Nom (1.02)** is in **accordance** to the **Mains Supply Voltage**, see *DCS 400 Manual; page 2-3 table 2.2/4*
- Parameter **Net Underv Trip (1.10)** is in a range of **-10...+5%**
- Parameter **Field Heat Ref (4.10)** = **0%** or **greater** than **Field Low Trip (4.06)**

Preparation

- Needed tools: Voltmeter 0...1000 V DC, perhaps an ON switch or customer's panel.
- Switch **all power OFF**
- **Disconnect** the **motor field** at terminals X10:1 and 2
- Connect a **Voltmeter** to terminals X10:1 and 2
- Connect an **ON switch** to terminals X4:7 (DI7-ON) and X4:9 (+24V) or use customer's panel

Necessary drive modifications

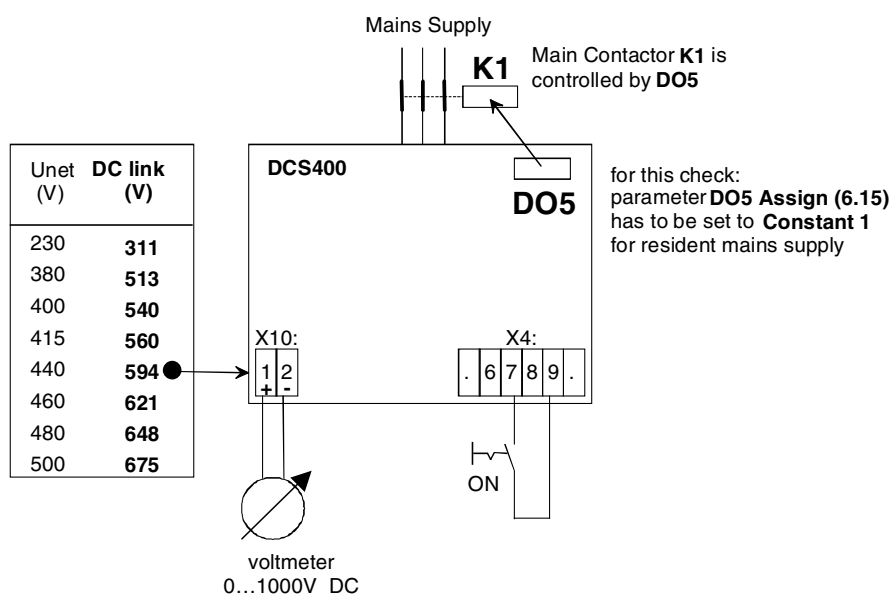


Fig. 5-1 Measures for test

Test field voltage

(Field disconnected)



Actions	Remarks
Be careful now because of high voltage at the unit.	Up to 700 V possible at terminals X10:
Switch on electronics supply.	
Connect mains supply.	If main contactor is controlled by digital output DO5 set parameter DO5 Assign (6.15) = Constant 1 to connect DCS 400 power part to mains supply, but remember old value of parameter 6.15 (mostly "macro depend").
Voltmeter should show 0 V .	If not: SDCS-FIS-3(A) is faulty / short circuit.
Switch on (ON=1) the drive.	
Volt meter should show the DC link voltage of the IGBT field exciter. DC link voltage = mains supply voltage * 1.35	If not: SDCS-FIS-3(A) is faulty / broken.
Switch off (ON=0) the drive within 10 sec.	Otherwise an alarm Field Volt Limited (A7) and a fault Field Undercurrent (F12) will occur and switch off the drive.
In any case Voltmeter should show 0 V again.	

Restore the drive to the original state

Original state means:

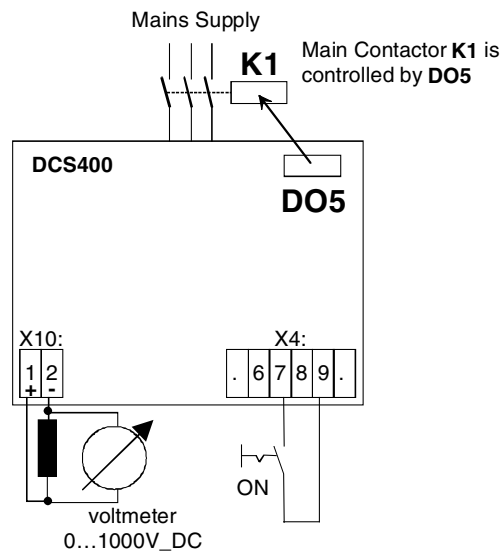
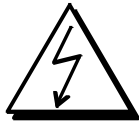


Fig. 5-2 Original state

Test field current

Test if field current regulator works right (field connected)

Actions	Remarks
Switch all power OFF .	
Disconnect the plug of terminal X10 and measure resistance (Re_{meas}) of motor field using an Ohmmeter.	Re_{meas} = measured value of field resistance.
Connect the plug again	
Calculate the resistance of motor field using field voltage nominal (U_e) and field current nominal (I_e) of motor name plate (warm state).	$Re_{calc} = U_{e_{motor\ name\ plate}} / I_{e_{motor\ name\ plate}}$
Compare the measured and calculated values in consideration of warm and cold state of the motor. Remember the deviation between warm and cold motor field is approx. -35%.	Re_{meas} is approx. Re_{calc} - 35%. It's only a first rough estimation. If the comparison is out of this range there is something wrong with the motor field .



Be careful now because of high voltage at the unit.	Up to 700 V possible at terminals X10:
Switch on electronics supply	
Switch on (ON=1, RUN=0) the drive.	Mains supply has to be available now.
Measure field voltage actual ($U_{e_{act}}$) of the motor using a Voltmeter.	Because of warm or cold state of motor field the deviation of the field voltage can be approx. -35% referring to the motor name plate.
Measure field current actual ($I_{e_{act}}$) using parameter Field Cur Act (4.02) .	If Field Cur Act (4.02) is not stable check stability of mains supply voltage, additionally refer to fault description F12/F13 (chapter 6) of the <i>DCS400 Manual</i> . Set temporary Net Underv Trip (1.10)=0% and Net Fail Time=0.5s
Calculate the resistance of motor field again using $U_{e_{act}}$ and $I_{e_{act}}$ values of the field.	$Re_{act} = U_{e_{act}} / I_{e_{act}}$
Values of motor field resistance measured by Ohmmeter and calculated by using actual values ($U_{e_{act}} / I_{e_{act}}$) have to be almost identical .	$Re_{meas} = Re_{act}$ If not there is something wrong with the SDCS-FIS-3(A) .

Exchange of Field Exciter Unit SDCS-FIS-3(A)

All DCS 400 converters are equipped with field exciter unit based on IGBT technology.

In order to keep the operating temperature of the IGBT module low, the joint between the heatsink and the module should have a good heat conducting ability. The electrical conductivity of the connectors must also be good. For this reason the following instructions must be observed with particular care.

Required Tools

Special tools or material needed in addition to standard tools for the exchange of field exciter units:

- torque socket spanner: 5 Nm (case to heatsink)
- torque screwdriver: 3 Nm (electrical connection)
- screws are metric type; use appropriate nuts
- thermal joint compound (silicon-free grease):
type Berlub FZ1/E3
number: GHSN 39 00 11 P1

Field exciter units are always mounted in the same direction, independent of current, voltage, number of quadrants (2-Q or 4-Q).



Before you start work, disconnect the converter completely from the power supply then check the voltage free condition and make sure, everything is located in an electrically and mechanically safe condition!

Disassemble Field Exciter Unit

Dismount field exciter unit as described in chapter 2, additionally pay attention to the following information.

In order to obtain access to the field exciter unit from the power interface board SDCS-PIN-3(A),

- loosen the screws C1, U1, V1, W1 and D1 as well as the bolts (with an 8 mm socket wrench) left and right on the PIN-board.
- detach the connectors X11, X14, X15, X16 and X22 on the PIN-board.
- unclamp the connecting cable of the filter choke L1 (sits directly on heatsink) from plug X100 and unwind the cable from the current transformer T2, see *Figure 5-3*.

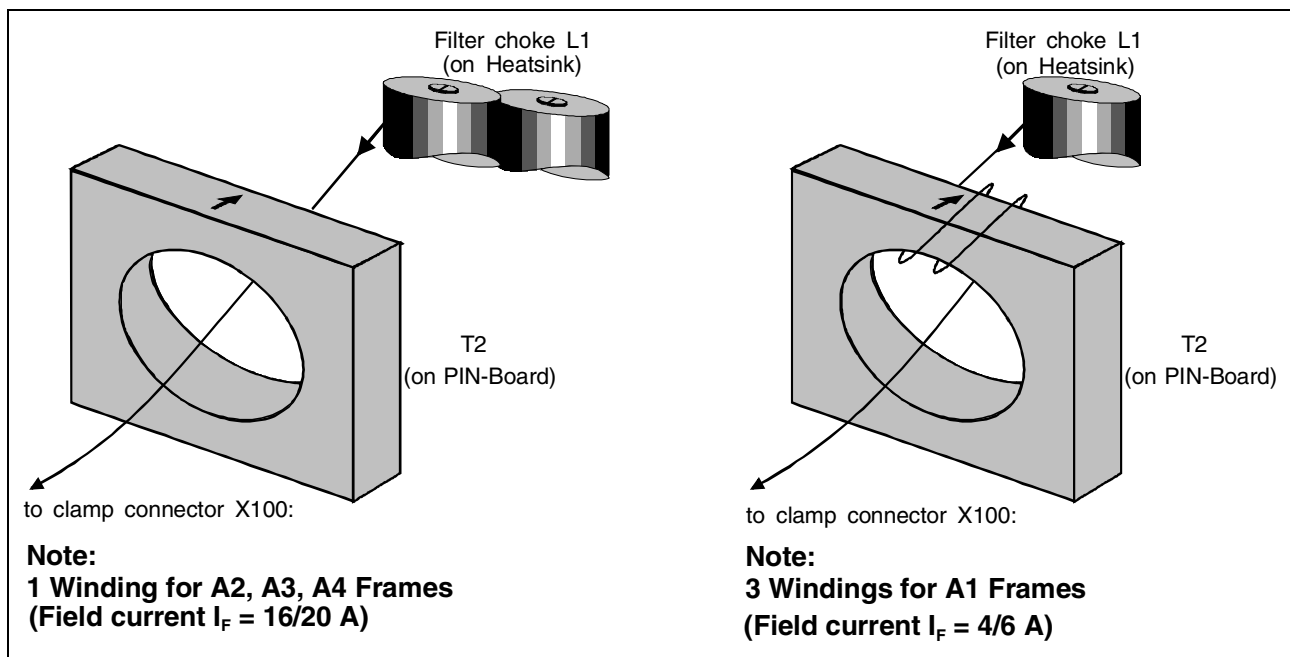


Figure 5-3 Direction and number of windings depending on the field current (type of frame)

- shift the power interface board together with the transparent plastic insulation (see Figure 5-6) towards the bottom of the converter and detach the connector X6 from the field exciter unit (FIS-board).

If the connecting cables of the connectors X1, X2, X7 as well as X3, X4, X5 are long enough the PIN-board can be shifted in order access the field exciter unit (FIS- board). Otherwise the power interface board and the transparent plastic insulation have to be removed completely by detaching the connectors X1, X2, X7 as well as X3, X4, X5 from the PIN-board.

Remove the field exciter unit (FIS- board) by carrying out the following instructions:

- Detach all connectors X1 to X5, X7 and X14 from the FIS. Be careful not to mix up the connectors!
- Unscrew the field exciter unit (see Figure 5-4) and mark it clearly.

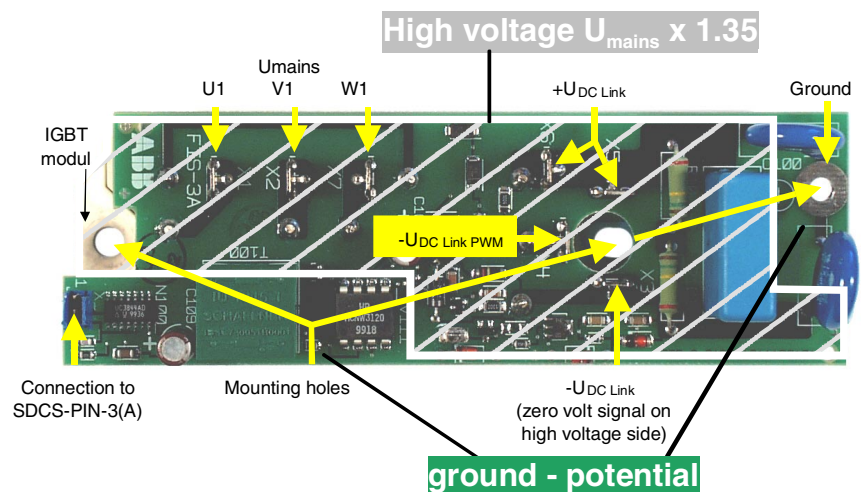


Figure 5-4 Field Exciter Unit SDCS-FIS-3A

Assemble new Field Exciter Unit

1. Remove old thermal joint compound (grease) from the heatsink. Preparation of the heatsink: if the area is clean, spread out the remaining heat-conducting compound with a rubber spatula or with the hand. If the area is dirty, wipe the heatsink surface clean with tissue paper. Clean the mounting surfaces with an appropriate solvent.
2. Apply a thin coat of thermal compound to the new IGBT-module of the new field exciter unit, refer to *Figure 5-5*. Spread the thermal joint compound evenly by moving the module forward and backward on the heatsink.

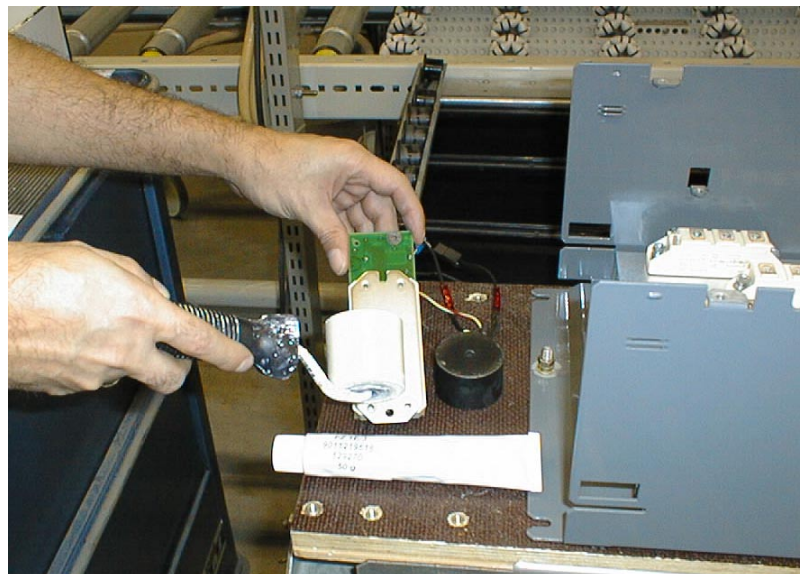


Figure 5-5 Application of thermal compound to IGBT-module

3. Tighten the clamping screws (IGBT-module to heatsink) to 5 Nm mounting torque and the screw for electrical connection to 3 Nm mounting torque (refer to *Figure 5-4*).
4. Reattach all connectors X1 to X5, X7 and X14 to the field exciter unit.
5. In order to ensure compatibility between revision stands of field exciter unit (FIS-board) and power interface board (PIN- board), refer to *Appendix C Compatibility Hardware/Software* for more information before continuing with step 6.

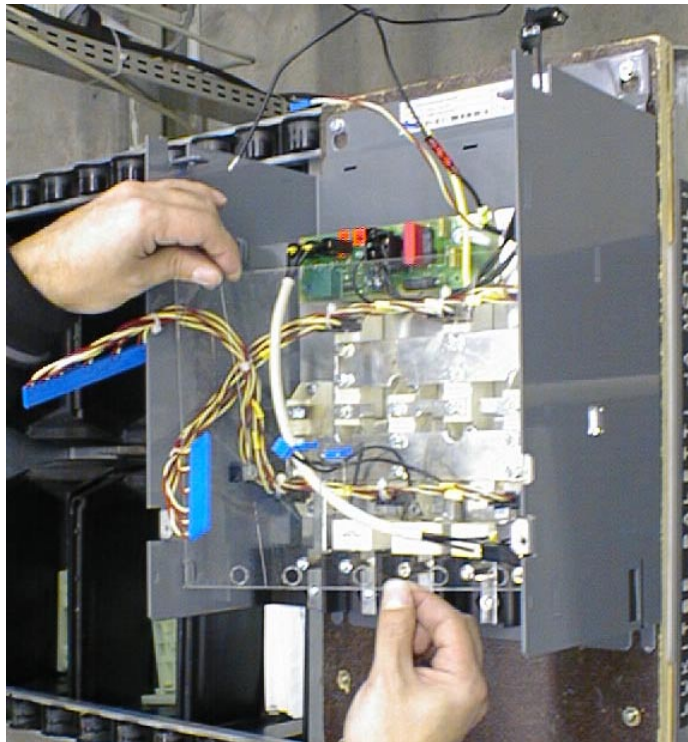


Figure 5-6 The transparent plastic insulation

6. Push the transparent plastic insulation (*Figure 5-6*) and the PIN-board back into place (see *Figure 5-7*), if they were not removed completely. Otherwise put them back in place. Reattach the connector X6 from PIN-board to FIS-board. Ensure that the connecting cables for the connectors X1, X2, X7 as well as X3, X4, X5 are led through the corresponding holes or slits to the front of the PIN-board.

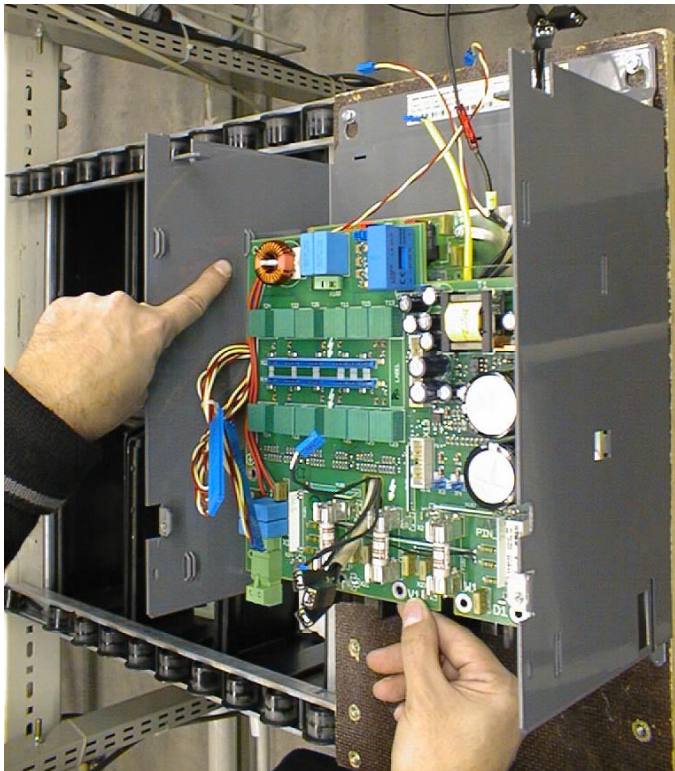


Figure 5-7 Positioning of the PIN-board

7. Reattach the connectors X1, X2, X7 as well as X3, X4, X5.
8. Reattach the connectors X11, X14, X15, X16 and X22.
9. Lead connecting cable from filter choke L1 **once** (for $I_F = 16/20$ A) or **three times** (for $I_F = 4/6$ A) through the current transformer T2 and clamp it to connector X100, see Figure 5-3.
10. Screw the PIN-board into place.
11. Reattach the ribbon cables on the controller panel to the connectors X12 and X13 on the PIN-board and screw the controller panel back into place.
12. Reattach the connecting cables to the dc-link capacitor.
13. Attach the top cover (with fan, in case of $I_{DC} \geq 45$ A) and the front cover and tighten the screws.

Chapter 6 - Thyristor Modules

Fault tracing

Thyristor problems can be noticed in two ways.

Thyristor diagnosis

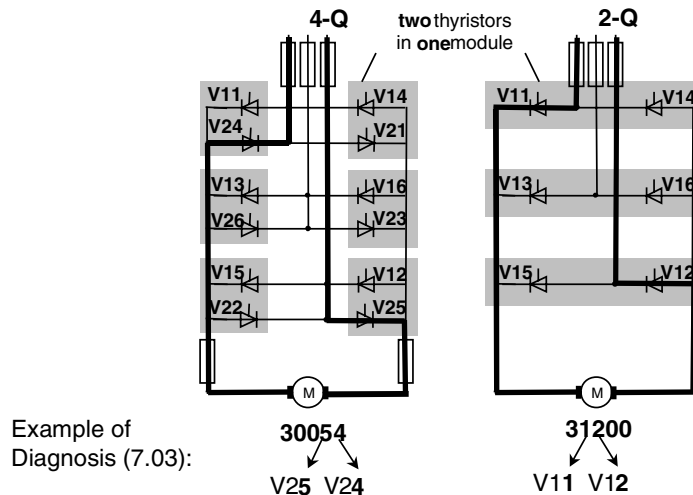
For testing that all the thyristors are o.k. or any is faulty an automatically thyristor diagnosis procedure can be started in parameter **Contr Service (7.02) = Thyr Diag**; see also *DCS 400 Manual* page 4-38.

- A test of short circuit and earth fault will be done for each single thyristor.
- A conductivity test of all thyristors will be done in pairs of two.
- If a test fails **Alarm 10 - Autotuning Failed** will be displayed at the panel.
- A faulty result will be shown as a number of the affected thyristors in parameter **Diagnosis (7.03)**.

Diagnosis result

Display format of diagnosis result:

3bbbb faulty thyristor diagnosis (b=thyristor bridge)
3 **3=Thyristor Diagnosis "conductivity test"**
b 1...6 = bridge 1, thyristor V11...V16 faulty
b 1...6 = bridge 1, thyristor V11...V16 faulty
b 1...6 = bridge 2, thyristor V21...V26 faulty
b 1...6 = bridge 2, thyristor V21...V26 faulty



Meaning of diagnosis messages:

30054 Thyristor Diagnosis

- 00** bridge 1 not concerned, thyristors V11...V16 o.k.
- 5** bridge 2 affected, thyristor V25 is faulty
- 4** bridge 2 affected, thyristor V24 is faulty

31200 Thyristor Diagnosis

- 1** bridge 1 affected, thyristor V11 is faulty
- 2** bridge 1 affected, thyristor V12 is faulty
- 00** bridge 2 not concerned, thyristors V21...V26 o.k.

Blown fuse

This is an indication, that a strong overcurrent has happened due to one of the following reasons:

- an internal short circuit between the phases (line side) because of a defective thyristor (short circuit inside a thyristor from anode to cathode)
- an internal short circuit between the phases (line side) because of circulating current in a 4-Q converter (malfunction of the control electronics, no thyristor defective)
- an external short circuit at the DC terminals of the converter without sufficient impedance
- a commutation fault during inverting mode operation (active braking with high current, high EMF and with low AC voltage)

Faulty thyristor

If a blown fuse is suspected in the converter, the problem is caused most often by a faulty thyristor. To be sure whether a thyristor is the reason and needs to be exchanged fault tracing must be done as described below.



In general, make sure, that all safety instructions, given within this manual or within the safety instructions, related to the machine or the application itself, are obeyed.

These converters require semiconductor fuses in the 3 lines.

- the converter must be disconnected from the mains
- one motor armature lead should be disconnected from the converter
- Using the OHM function of a normal multimeter, measurements must be made from each AC terminal to each DC terminal (U1 to C1, V1 to C1, W1 to C1, U1 to D1, V1 to D1, W1 to D1; see basic drawing of the power section); normally, every measurement should show high resistance ($> 1 \text{ k}\Omega$); target: find a short circuit, indicated by low resistance ($< 1 \Omega$) (destroyed thyristor).
- If the converter is designed with half-bridge thyristor modules, as in the case of four-quadrant (4Q) converters, then a module consists of two anti-parallel thyristors. In this case it is sufficient to know which thyristor pair or module has a defective thyristor because the complete module must be replaced.
- After a thyristor module is replaced, the above-mentioned measurement should be done another time to make sure that all faulty thyristors have been detected!

Note

The RC snubber circuit could also cause 0Ω result for a short time. The measurement, showing less resistance than 1Ω should be made a second time with test leads applied to the terminals with the opposite polarity; if this measurement shows the same result, one or two thyristors located in that path are faulty; they need to be replaced.

Firing pulses

- The firing pulses are designed to drive thyristor modules
- The amplitude of the pulses is min. 300 mA (typ. 600 mA) with min. 500mA (typ. 800mA) at the beginning
- The current rise is more than 1A/μs

Generation

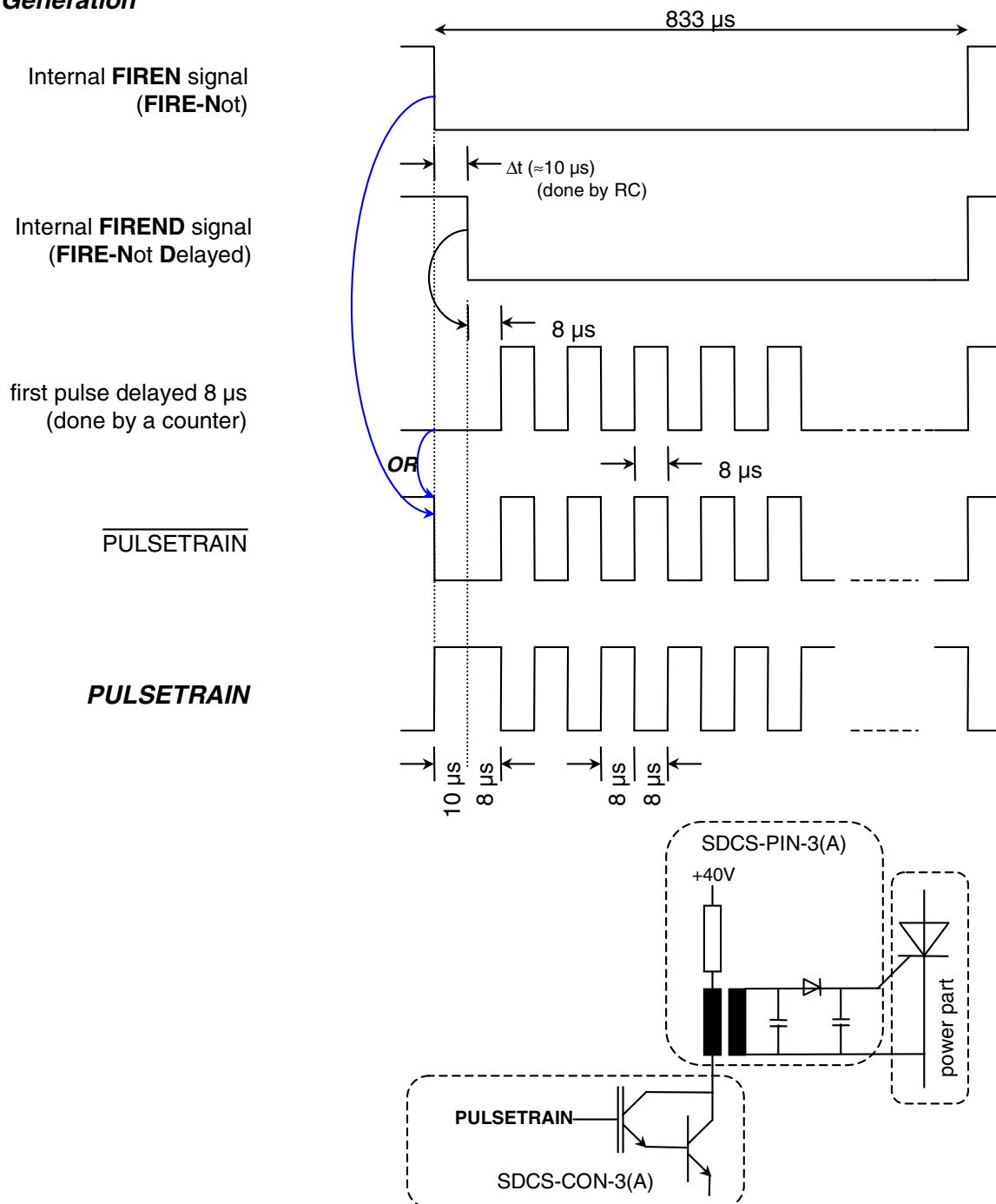
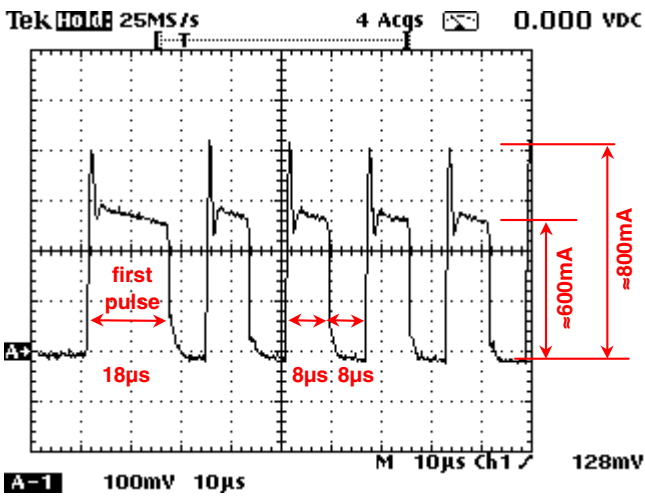


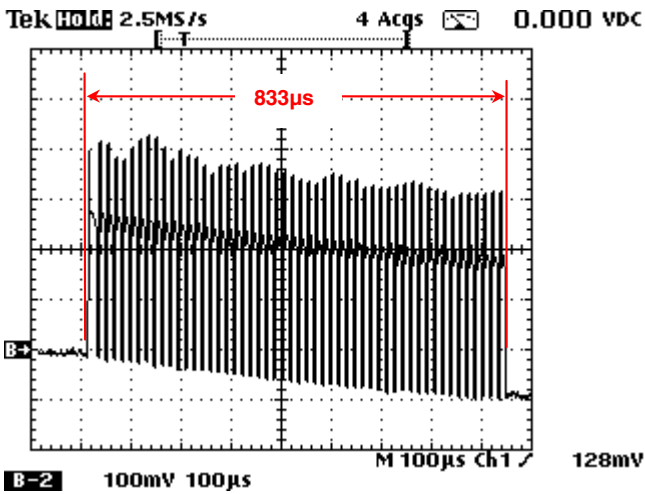
Figure 6-1 Generation of firing pulses

Power measuring values

zoom of the start firing pulses



total length of pulsetrain 833 µs



pulse sequence per phase

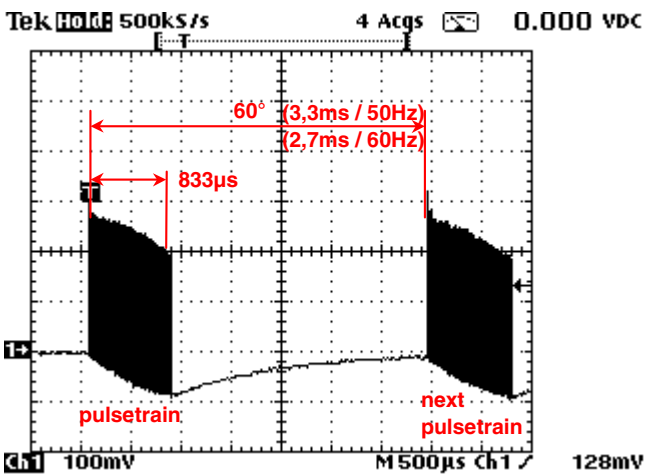


Figure 6-2 Measuring values of firing pulses with an AC current probe

Temperature of thyristor bridge

Maximum permitted temperature of thyristor bridge are given in the table below.

Converter module	Fault level (F7) °C	Alarm level (A4) (F7 – 5°C) °C
DCS401.0020	109	104
DCS401.0045	64	59
DCS401.0065	68	63
DCS401.0090	74	69
DCS401.0125	86	81
DCS401.0180	73	68
DCS401.0230	76	71
DCS401.0315	86	81
DCS401.0405	88	83
DCS401.0500	84	79
DCS401.0610	91	86
DCS401.0740	76	71
DCS401.0900	88	83
DCS402.0025	109	104
DCS402.0050	74	69
DCS402.0075	79	74
DCS402.0100	87	82
DCS402.0140	101	96
DCS402.0200	73	68
DCS402.0260	78	73
DCS402.0350	84	79
DCS402.0450	81	76
DCS402.0550	82	77
DCS402.0680	90	85
DCS402.0820	93	88
DCS402.1000	90	85

Snubber circuit

In the modules of the DCS 400 series the snubber circuit is divided in two parts, the dV/dt limitation and the over voltage protection. The advantage is, that the RC-snubber circuit is very small and so the power consumption is small. Because every thyristor has its own RC-snubber, there is no point of operation in which a thyristor is unprotected.

The voltage rise is limited to less than 1000 V/ μ s. The overvoltage protection is laid out as a combined snubber circuit at the AC side of the thyristors. The normally used discharging resistor of this network is substituted by a step down chopper which feeds the motor field. This reduces the power losses in the converter very much. E.g. with a 700 A unit about 800 W are saved.

The overvoltage protection is only needed when the converter is running in the continuous current flow of the armature current. During pulsating D.C. operation there is nothing to commutate and therefore there is no overvoltage. There are no inverse currents in the thyristors that will cause overvoltages together with the line chokes.

Because the discharging of the capacitor of the overvoltage protection is done by the chopper, it is necessary that a field current is flowing all the time. An operation without connected motor field is not allowed. The minimum current that has to flow is 0.1 A for A1 converter units and 0.3 A for A2...A4 units. This is guaranteed by the converter typecode.

The field exciter should not be tried to work without load because of risk of damaging the output filter capacitors of the field exciter unit.

The capacitor of the field exciter unit is chosen to withstand the transient overvoltages defined in EN61800-3 and to protect the semiconductors of the converter. There are no longer any varistors needed to protect the thyristors.

General Instruction for Handling Semiconductors

Thyristor modules and busbars have to be mounted to the correct torque using a torque screw driver or torque wrench.

Always mark components suspected to be damaged clearly after removing them from the circuit, to avoid confusion with "good" components.

When removing a damaged semiconductor, note **which way it was installed** on the heatsink.

Be sure that the new and old component have the same type designation or that the new component can replace the old one. A semiconductor can be replaced by different manufacturers' compatible semiconductor according to the codes in the table (refer to Appendix A).

Semiconductor components are high-precision products. All unnecessary tools and articles constitute a risk of damage to the easily dented and scratched surfaces and to the semiconductors in general.

1. Keep new semiconductors as long as possible in their original packages.
2. Use protective gloves if possible.
3. Clean work station and hands frequently.
4. Use good lighting.

Exchange of Thyristor Module

All DCS 400 converters are equipped with thyristor **modules**. In order to keep the operating temperature of the semiconductor module low, the joint between the heatsink and the module should have a good heat conducting ability. The electrical conductivity of the connectors must also be good. For this reason the following instructions must be observed with particular care.

Required Tools

Special tools or material needed in addition to standard tools for the exchange of thyristor modules:

- torque spanner: 5 or 6 Nm (thyristor module to heatsink)
3, 5, 9 or 12 Nm (electrical connections)
see Table 6-2
- screws are metric type; use appropriate nuts
- thermal joint compound (silicon-free grease):
type Berlub FZ1/E3
number GHSN 39 00 11 P1



Before the work is started, disconnect the converter from the power supply completely, then check the voltage free condition and make sure, everything is located in an electrical and mechanical safe condition!

Disassemble Thyristor modules

Dismount field exciter unit as described in chapter 2, additionally pay attention to the following information.

In order to remove the power interface board SDCS-PIN-3(A),

- loosen the screws C1, U1, V1, W1 and D1 as well as the bolts (with an 8 mm socket wrench) left and right on the PIN-board
- detach the connectors X11, X14, X15, X16 and X22 on the PIN-board
- unclamp the connecting cable of the filter choke L1 (sits directly on heatsink) from plug X100 and unwind the cable from the current transformer T2, see *Figure 5-3*.
- detach the connectors X1, X2, X7 as well as X3, X4, X5 and X6 from the PIN-board and remove the PIN-board.
- remove the transparent plastic insulation (see *Figure 5-6*).

The busbars, thyristors and their connecting wires or cables can now be accessed.

- Remove the gate wires from the faulty thyristor module and mark the position of the trigger connections on the cable.
- Remove the busbars necessary to obtain full access to faulty thyristor module(s).
- Remove only as many parts as needed around the faulty module. If the current transformer must be removed, mark the position and the connections!
- Remove the faulty thyristor module and mark it.

Assemble the new module

- Remove old thermal joint compound (grease) from the heatsink and prepare the heatsink as follows: if the area is clean, spread out the remaining heat-conducting compound with a rubber spatula or with the hand. If the area is dirty, wipe the heatsink surface clean with tissue paper. Clean the mounting surfaces with an appropriate solvent.

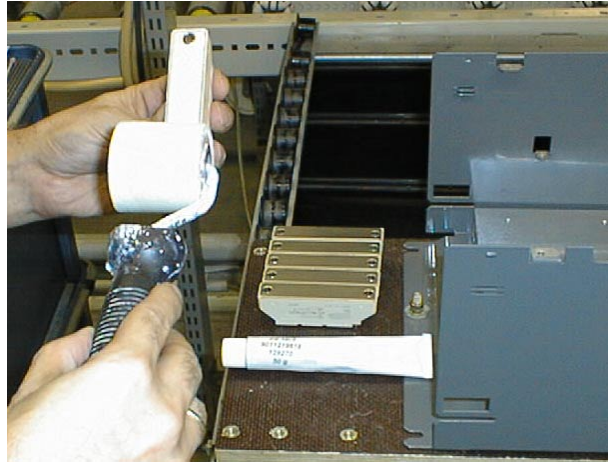


Figure 6-3 Application of thermal compound to thyristor module

- Apply a thin coat of thermal joint compound to the new module. Spread the thermal joint compound evenly by moving the module forward and backward on the heatsink.

- Tighten the clamping screws until the screw heads touch the bottom of the module. Then tighten the screws to 2.5 Nm pre torque. If the module is mounted using four screws, tighten the screws crosswise.
- Tighten the screws to nominal torque (see *Table 6-1*).
- Reinstall the busbars; make sure, the correct torque is applied and reconnect all leads.
- Reattach the transparent plastic insulation and PIN-board (see *Figures 5-6 and 5-7*). Ensure that the connecting cables for the connectors X1, X2, X7 as well as X3, X4, X5 are led through the corresponding holes or slits to the front of the PIN-board.
- Reattach the connectors X1, X2, X7 as well as X3, X4, X5 and X6.
- Reattach the connectors X11, X14, X15, X16 and X22.
- Lead connecting cable from filter choke L1 **once** (for $I_F = 16/20$ A) or **three times** (for $I_F = 4/6$ A) through the current transformer T2 and clamp it to connector X100, see *Figure 5-3*.
- Screw the PIN-board into place.
- Reattach the ribbon cables on the controller panel to the connectors X12 and X13 on the PIN-board and screw the controller panel back into place.
- Reattach the connecting cables to the dc-link capacitor.
- Attach the top cover (with fan, in case of $I_{DC} \geq 45$ A) and the front cover and tighten the screws.

Thyristor module		Nominal mounting torque	
Size	Type	Electrical connections	Module to heatsink
20 mm block	SKKT 27, 42, 57, 106	3 Nm	5 Nm
20 mm block	MCC 26, 44, 56, 95	2.5...4 Nm	2.5...4 Nm
34 mm block	SKKT 162	5 Nm	5 Nm
34 mm block	TT 162	6 Nm	6 Nm
50 mm block	TT 250, 330	12 Nm	6 Nm
60 mm block	TT 425, 570	12 Nm	6 Nm

Table 6-1 Nominal mounting torque for thyristor modules

**Thyristor module location in
DCS 401 (2-Q) units**

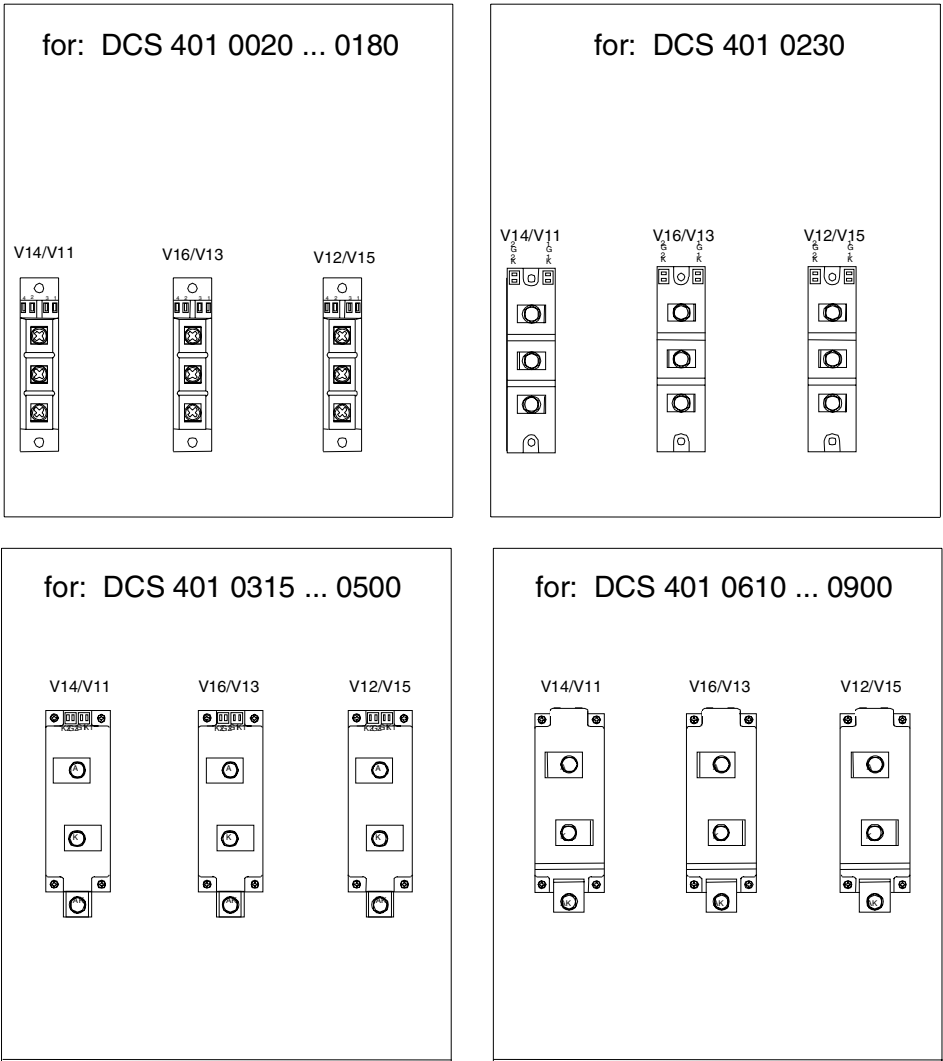


Figure 6-4 Location of thyristor modules in DCS 401 (2Q) units

**Thyristor module location in
DCS 402 (4-Q) units**

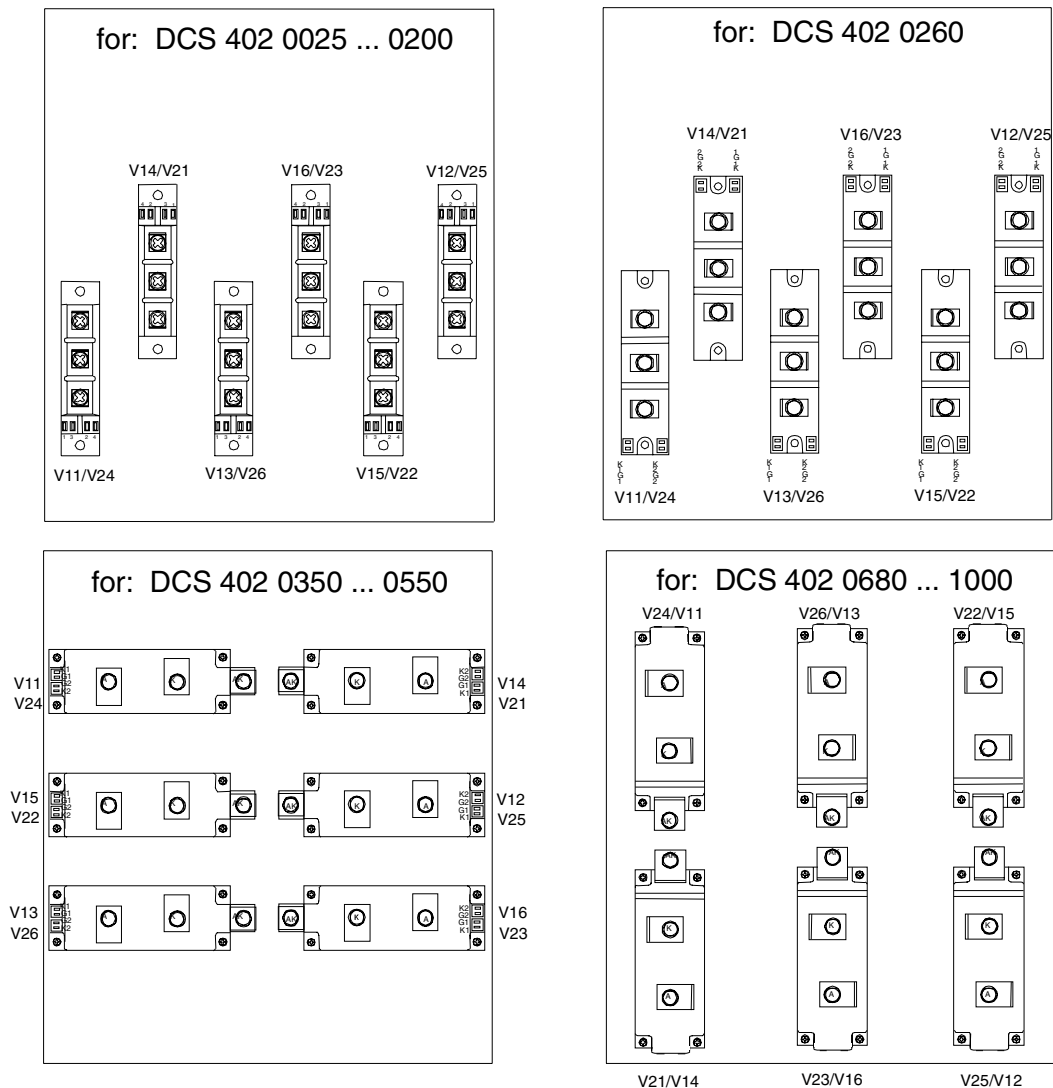


Figure 6-5 Location of thyristor modules in DCS402 (4Q) units

Module terminals

The next figures show the terminals of thyristor modules. The terminals of modules are also stamped or marked by a sticker on the modules.

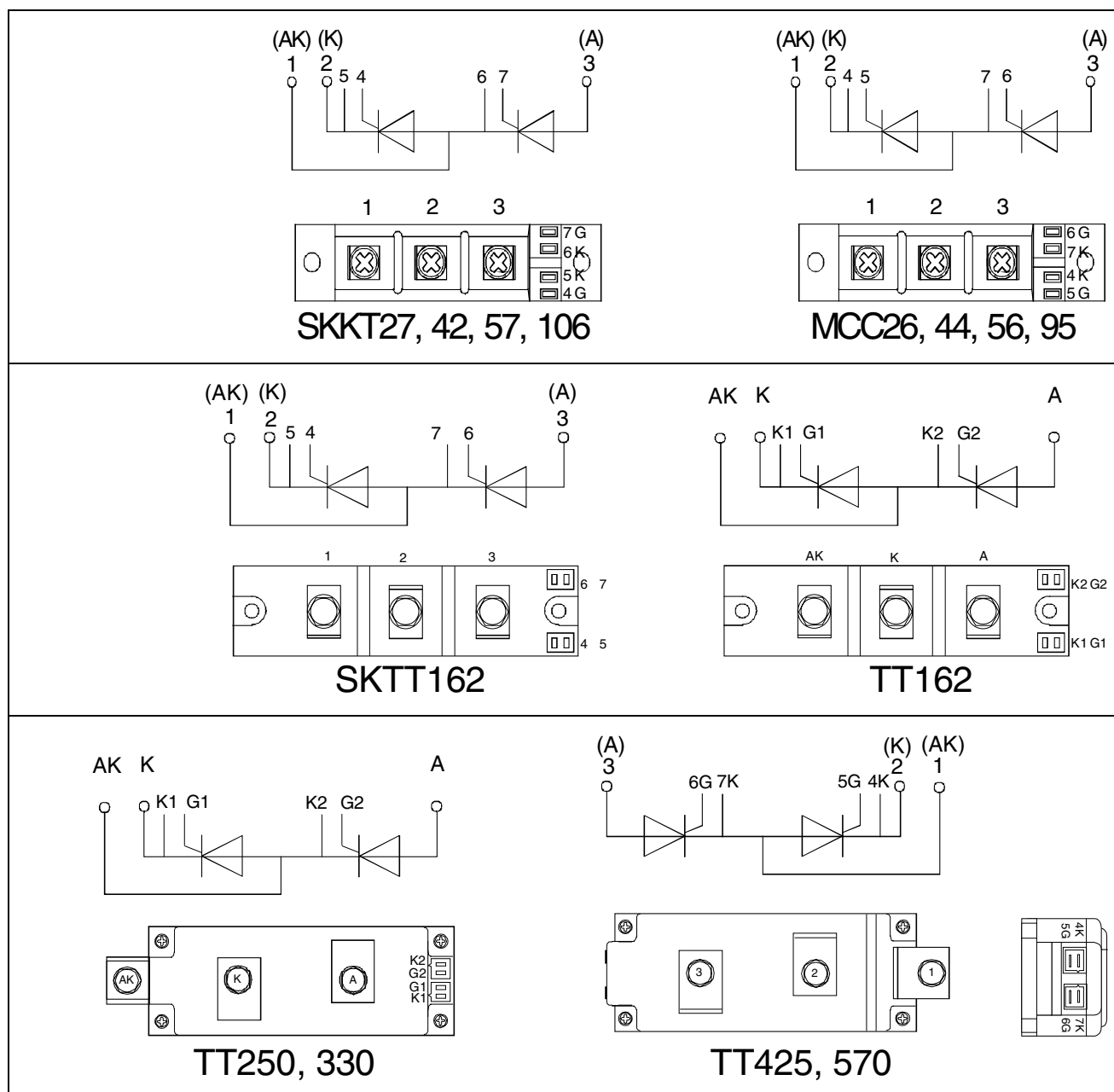


Figure 6-6 Terminals of half-bridge thyristor modules

Chapter 7 - Preventive Maintenance

Recommended Regular Maintenance

Certain items should be checked regularly to ensure a problem-free operation.

Air Filters

If air filters are used, the cleanliness of filters should be checked according to the ambient conditions so that obstructed filters do not prevent the cooling of the DCS 400.

Fan

Bearings of the cooling fan motor should be checked (e.g. once a year) and the fan should be replaced if the bearings are not in good condition.

Heatsink

The DCS converter can run into overtemperature faults if the heatsink is not clean. In normal environment, the heatsink should be checked and cleaned annually.

Use compressed dry air to remove dust from the heatsink. (The air-flow direction must be from bottom to top). Also, use a vacuum cleaner at the air outlet to trap the dust. Fan rotation must be prevented in order to prevent bearing wear.

Appendix A - Spare Parts List

Spare parts quick finder for 2-Quadrant (2-Q) DCS 400 series (DCS 401.0xxx)

				DCS401.																
description-title	type	ABB-ident.-no.	each kg	0020	0045	0065	0090	0125	0180	0230	0315	0405	0500	0610	0740	0900	0610.52	0740.52	0900.52	
control board	SDCS-CON-3 "A" with software	3ADT 312000 R0001	0,3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
power interface board	SDCS-PIN-3 "A"	3ADT 312200 R0001	0,7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
field supply	SDCS-FIS-3 "A"	3ADT 312100 R0001	0,2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
panel adapter for DCS 400		3ADT 310700 R0001	0,01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
operating panel	DCS400-PAN	3ADT 220077 R0001	0,1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
thyristormodule	SKKT 27B / 16 E	3ADC 340063 P0001	0,1	X	X															
thyristormodule	SKKT 42B / 16 E	3ADC 340067 P0001	0,1			X														
thyristormodule	SKKT 57B / 16 E	3ADC 340068 P0001	0,1				X													
thyristormodule	SKKT 106B / 16 E	3ADC 340064 P0001	0,1					X	X											
thyristormodule	SKKT 162 / 16 E	DCA 0011965 P0001	0,3							X										
thyristormodule	TT 250 N 16 KOF-AK34	3ADC 340060 P0002	0,85								X	X								
thyristormodule	TT 330 N 16 KOF	3ADC 340065 P0001	0,85										X							
thyristormodule	TT 425 N 16 KOF	3ADC 340032 P0001	1,5											X			X			
thyristormodule	TT 570 N 16 KOF	3ADC 340066 P0001	1,5												X	X		X	X	
semiconductor fuse	170 M 1564 50A / 660V	DCZ 9838767 P0001	0,15	X																
semiconductor fuse	170 M 1566 80A / 660V	DCZ 9838791 P0001	0,15		X															
semiconductor fuse	170 M 1568 125A / 660V	DCA 0012686 P0001	0,15			X	X													
semiconductor fuse	170 M 3815 200A / 660V	DCA 0012694 P0001	0,4					X	X											
semiconductor fuse	170 M 3816 250A / 660V	3ADC770024 P0009	0,4																	
semiconductor fuse	170 M 3817 315A / 660V	3ADC770024 P0010	0,4							X										
semiconductor fuse	170 M 5810 500A / 660V	DCA 0012708 P0001	0,6								X									
semiconductor fuse	170 M 6811 700A / 660V	DCA 0012716 P0001	1,2									X	X							
semiconductor fuse	170 M 6813 900A / 660V	DCA 0012724 P0001	1,2											X	X		X	X		
semiconductor fuse	170 M 6166 1250A / 660V	DCA 0012741 P0001	0,9													X			X	
temperature sensor	KTY 10-6-M4 (230 mm)	DCA 0012139 P0002	0,01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
temperature sensor	KTY 10-6-M4 (550 mm)	DCA 0012139 P0001	0,01													X			X	
fuse (F100-102 ; PIN3)	KTK 15 (10 x 38 mm)	GHSN640010P0003	0,01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
fan (115V 50/60Hz)	CN 2 B 2	3ADT 754014 P0001	0,6		X	X	X	X	X	X	X	X	X							
fan (230V 50/60Hz)	W2E 200-HH38-06	DCA 0012171 P0001	2											X	X					
fan (115V 50/60Hz)	W2E 200-HH86-14	3ADT 754012 P0001	2														X	X		
fan (230V 50/60Hz)	W2E 250-HL06-08	3ADT 754016 P0001														X				
fan (115V 50/60Hz)	W2E 250-HL08-09	3ADT 754015 P0001																	X	

Note: Spare parts for DCS 400 differ from those for DCS 500 / DCS 600, even if the type names are identical

Spare parts quick finder for 4-Quadrant (4-Q) DCS 400 series (DCS 402.0xxx)

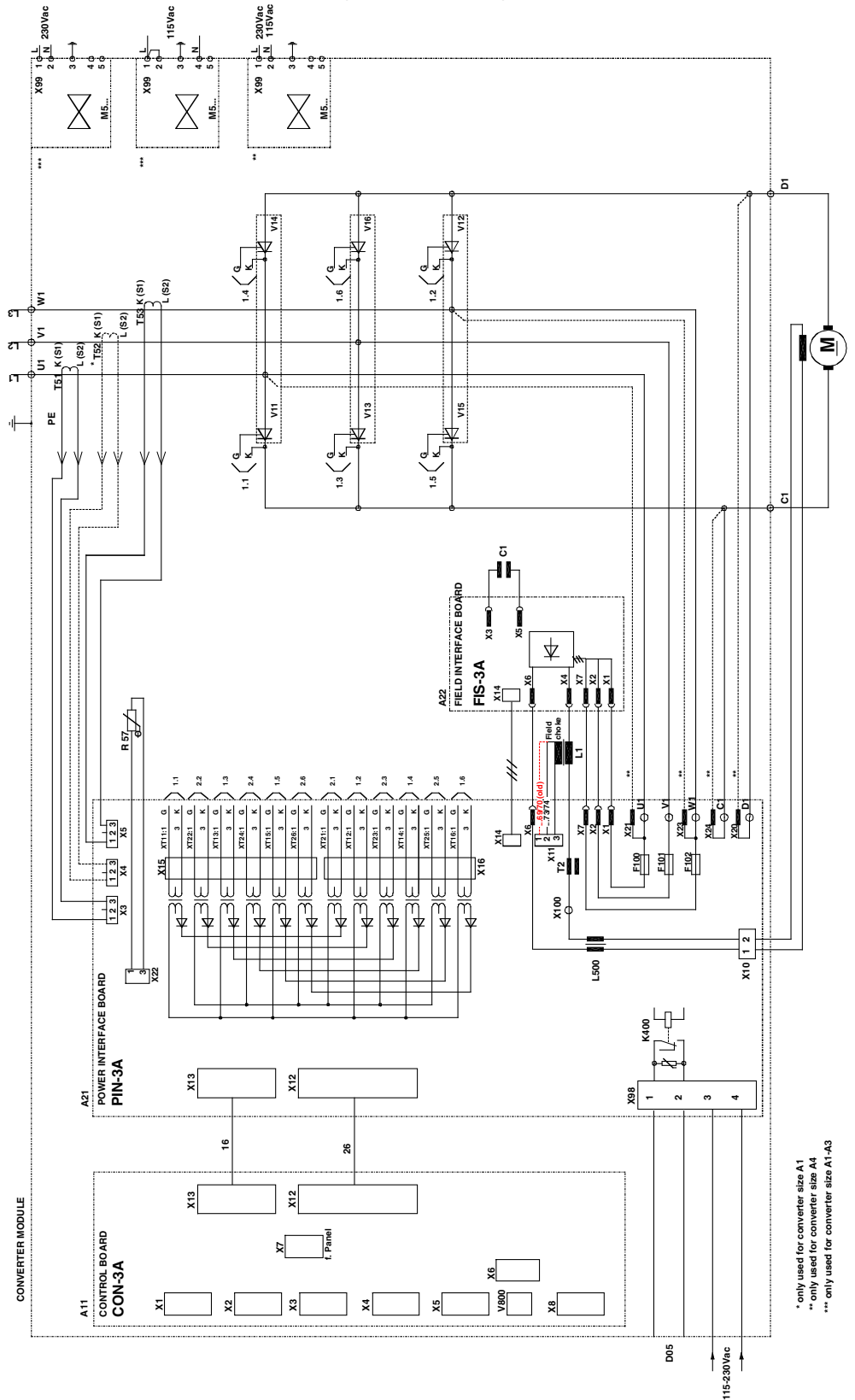
				DCS402.																
description-title	type	ABB-ident.-no.	each kg	0025	0050	0075	0100	0140	0200	0260	0350	0450	0550	0680	0820	1000	0680.52	0820.52	1000.52	
control board	SDCS-CON-3 "A" with software	3ADT 312000 R0001	0,3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
power interface board	SDCS-PIN-3 "A"	3ADT 312200 R0001	0,7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
field supply	SDCS-FIS-3 "A"	3ADT 312100 R0001	0,2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
panel adapter for DCS 400		3ADT 310700 R0001	0,01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
operating panel	DCS400-PAN	3ADT 220077 R0001	0,1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
thyristormodule	SKKT 27B / 16 E	3ADC 340063 P0001	0,1	X	X															
thyristormodule	SKKT 42B / 16 E	3ADC 340067 P0001	0,1			X														
thyristormodule	SKKT 57B / 16 E	3ADC 340068 P0001	0,1				X													
thyristormodule	SKKT 106B / 16 E	3ADC 340064 P0001	0,1					X	X											
thyristormodule	SKKT 162 / 16 E	DCA 0011965 P0001	0,3							X										
thyristormodule	TT 250 N 16 KOF-AK34	3ADC 340060 P0002	0,85								X	X								
thyristormodule	TT 330 N 16 KOF	3ADC 340065 P0001	0,85										X							
thyristormodule	TT 425 N 16 KOF	3ADC 340032 P0001	1,5											X			X			
thyristormodule	TT 570 N 16 KOF	3ADC 340066 P0001	1,5												X	X		X	X	
semiconductor fuse	170 M 1564 50A / 660V	DCZ 9838767 P0001	0,15	X																
semiconductor fuse	170 M 1566 80A / 660V	DCZ 9838791 P0001	0,15		X															
semiconductor fuse	170 M 1568 125A / 660V	DCA 0012686 P0001	0,15			X	X													
semiconductor fuse	170 M 3815 200A / 660V	DCA 0012694 P0001	0,4					X												
semiconductor fuse	170 M 3816 250A / 660V	3ADC770024 P0009	0,4						X											
semiconductor fuse	170 M 3817 315A / 660V	3ADC770024 P0010	0,4							X										
semiconductor fuse	170 M 5810 500A / 660V	DCA 0012708 P0001	0,6								X									
semiconductor fuse	170 M 6811 700A / 660V	DCA 0012716 P0001	1,2									X	X							
semiconductor fuse	170 M 6813 900A / 660V	DCA 0012724 P0001	1,2												X	X		X	X	
semiconductor fuse	170 M 6166 1250A / 660V	DCA 0012741 P0001	0,9													X			X	
temperature sensor	KTY 10-6-M4 (230 mm)	DCA 0012139 P0002	0,01	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	
temperature sensor	KTY 10-6-M4 (550 mm)	DCA 0012139 P0001	0,01													X			X	
fuse (F100-102 ; PIN3)	KTk 15 (10 x 38 mm)	GHSN640010P0003	0,01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
fan (115V 50/60Hz)	CN 2 B 2	3ADT 754014 P0001	0,6		X	X	X	X	X	X	X	X	X							
fan (230V 50/60Hz)	W2E 200-HH38-06	DCA 0012171 P0001	2												X	X				
fan (115V 50/60Hz)	W2E 200-HH86-14	3ADT 754012 P0001	2															X	X	
fan (230V 50/60Hz)	W2E 250-HL06-08	3ADT 754016 P0001														X				
fan (115V 50/60Hz)	W2E 250-HL08-09	3ADT 754015 P0001																	X	

Note: Spare parts for DCS 400 differ from those for DCS 500 / DCS 600, even if the type names are identical

If you have any questions concerning additional spare parts, please contact your local ABB-agent!

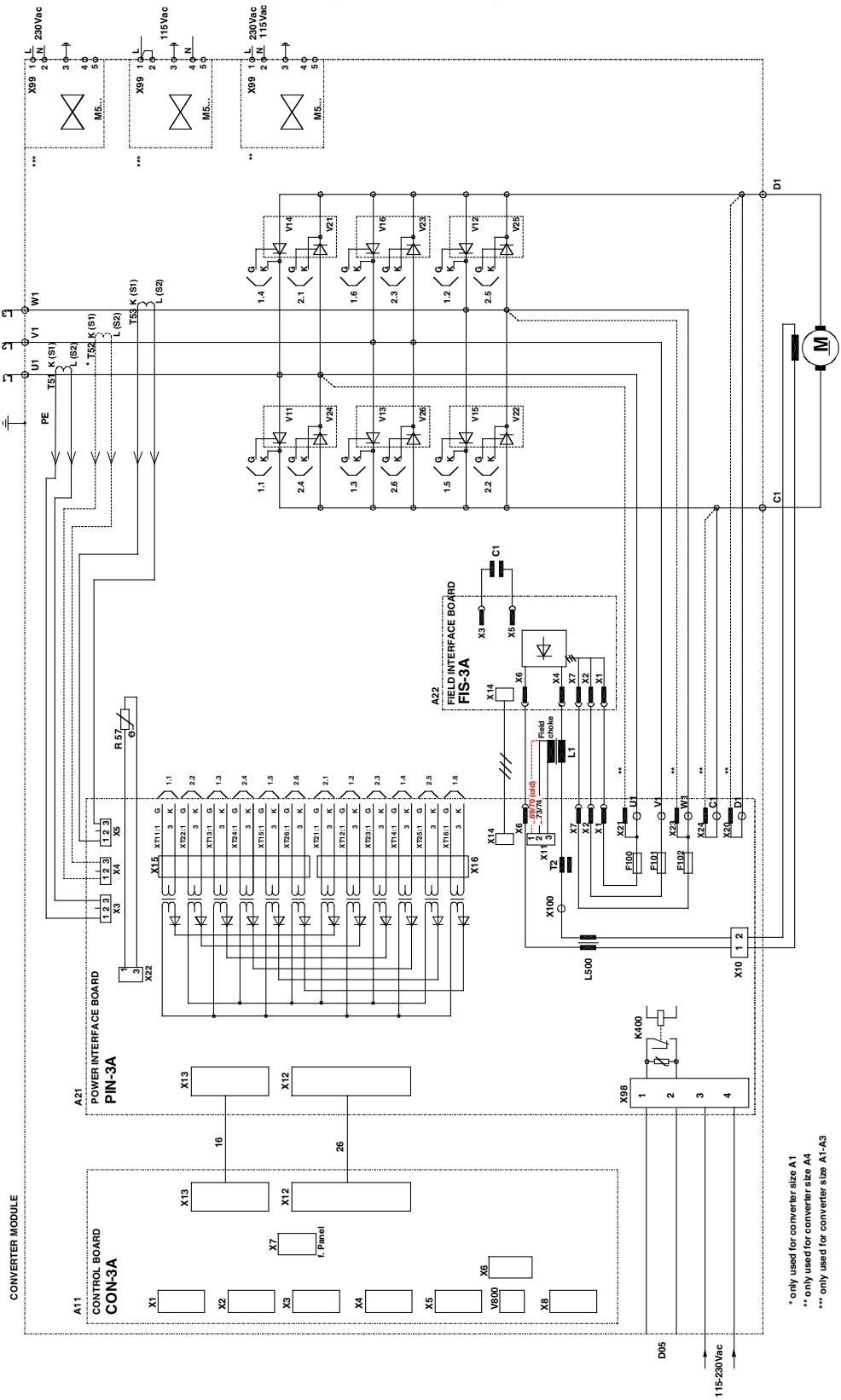
Appendix B - Circuit diagrams

Block diagram DCS 401 Overview of DCS 401 (2-Q converter)



* only used for converter size A1
 ** only used for converter size A4
 *** only used for converter size A1-A3

Block diagram DCS 402 Overview of DCS 402 (4-Q converter)



Appendix C - Compatibility Hardware / Software

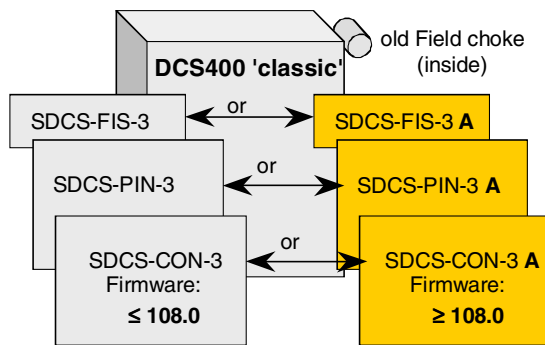
PCB's as spare parts

Note:

- The old PCB's (SDCS-CON-3 / -PIN-3 / -FIS-3) from DCS 400 **classic** can be replaced by new PCB's like (SDCS-CON-3A / -PIN-3A / -FIS-3A).
- The existing field choke (3ADT748069/70) **must not be** replaced by a new field choke type.
- The **DCS 400 Rev. A** expect PCB's with index **A** only.

Hints for service affairs:

- Keep **only new PCB's** on stock (SDCS-CON-3A / SDCS-PIN-3A / SDCS-FIS-3A).
- New PCB's are compatible to old PCB's but not vice versa!**



DCS 400 **classic**, permissible configuration

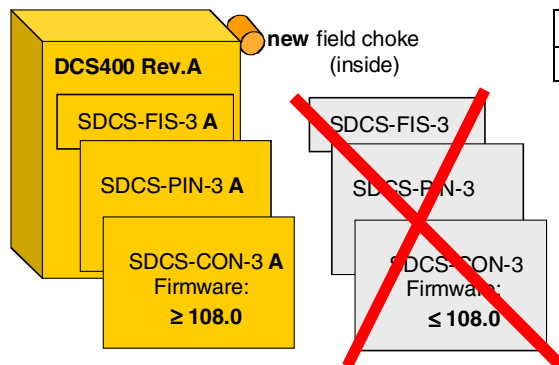
Config.	SDCS-	SDCS-	SDCS-	firmware / panel
1	-CON-3	-PIN-3	-FIS-3	107.x / 3.00 or 108.0 / 4.00
2	-CON-3	-PIN-3	-FIS-3A	107.x / 3.00 or 108.0 / 4.00
3	-CON-3	-PIN-3A	-FIS-3	107.x / 3.00 or 108.0 / 4.00
4	-CON-3	-PIN-3A	-FIS-3A	107.x / 3.00 or 108.0 / 4.00
5	-CON-3A	-PIN-3	-FIS-3	108.0 / 4.00
6	-CON-3A	-PIN-3	-FIS-3A	108.0 / 4.00
7	-CON-3A	-PIN-3A	-FIS-3	108.0 / 4.00
8	-CON-3A	-PIN-3A	-FIS-3A	108.0 / 4.00

- SDCS-CON-3 runs with firmware 107.x or 108.0
- SDCS-CON-3A runs with firmware 108.0 **only**.

Caution:

Even, if all PCB's are replaced by new PCB's with index **A**, the unit is still a **DCS 400 classic**!

Therefore use panel function **Set Typecode** and select **Revision = without**.



DCS 400 **Rev. A**, permissible configuration

Config.	SDCS-	SDCS-	SDCS-	firmware / panel
1	-CON-3A	-PIN-3A	-FIS-3A	108.0 / 4.00

Caution:

PCB's with index **A** can be replaced by PCB's with index **A** only!

Therefore use panel function **Set Typecode** and select **Revision = Rev A.x**

Comparison of features The table below shows the features depending on the different hard- and software possibilities.

Feature	Advanced, new DCS 400 Rev A	„Classic“ DCS 400 without Rev.	„Classic“ DCS 400 without Rev. but SW 108.0	„Classic“ DCS 400 without Rev. but CON-3A SW 108.0
Hardware Configuration	SW 108.0	SW 107.x		
other board configurations are not allowed	SDCS-CON-3A	SDCS-CON-3	SDCS-CON-3	SDCS-CON-3A
	SDCS-PIN-3A	SDCS-PIN-3	SDCS-PIN-3	SDCS-PIN-3 or SDCS-PIN-3A
	SDCS-FIS-3A	SDCS-FIS-3 or SDCS-FIS-3A (*)	SDCS-FIS-3 or SDCS-FIS-3A	SDCS-FIS-3 or SDCS-FIS-3A
	new field choke (3ADT748073/74) (inside)	old field choke (3ADT748069/70) (inside)	old field choke (3ADT748069/70) (inside)	old field choke (3ADT748069/70) (inside)
Drive Firmware Version	108.0	107.3	108.0	108.0
DCS400PAN Version	4.00	3.00	4.00	4.00
Documentation (Manual)				
3ADW 000 095	R0501 Rev E	R0401 Rev D	for HW: ...Rev D for SW: ...Rev E	PIN-3 / FIS-3: Rev D CON-3A / SW: Rev E
Resolution:				
Analogue Inputs 1+2	12 bits incl. sign	10 bits incl sign	10 bits incl sign	12 bits incl. sign
Accuracy	0.05%	0.2%	0.2%	0.05%
Analogue Outputs 1+2	12 bits incl. sign	8 bits incl. sign	8 bits incl. sign	12 bits incl. sign
Accuracy	0.05%	0.8%	0.8%	0.05%
Tacho Input	12 bits incl. sign	10 bits incl. sign	10 bits incl. sign	12 bits incl. sign
Accuracy	0.06%	0.25%	0.25%	0.06%
Analogue Outputs 1+2 max. scaling	11.00 V	10.00 V	10.00 V	11.00 V
Field Voltage range	50 V...440 V	50 V...350 V	50 V...350 V	50 V...350 V
Field Current range:				
A1 (20...25A unit)	0.1... 4 A	0.1... 6 A	0.1... 6 A	0.1... 6 A
A1 (45...140A unit)	0.1... 6 A	0.1... 6 A	0.1... 6 A	0.1... 6 A
A2	0.3...16 A	0.3...12 A	0.3...12 A	0.3...12 A
A3	0.3...16 A	0.3...14 A	0.3...14 A	0.3...14 A
A4	0.3...20 A	0.3...16 A	0.3...16 A	0.3...16 A
New Features:				
Tacho Offset Adjustment	1		1	1
Control of Bridge 1 by Digital Input	1		1	1
Control of Bridge 2 by Digital Input	1		1	1
Parameter and Signal for Arm Curr Level	1		1	1
Signal for Speed Ref at Ramp Gen- erator Input	1		1	1
Signal for Field Current actual is ok	1		1	1
Signal for Speed Measurement Fault	1		1	1
Signal for Mains Voltage Low	1		1	1
Fault Logger power failure save	1		1	1
Note:				
<ul style="list-style-type: none">The old PCB's (SDCS-CON-3 / -PIN-3 / -FIS-3) from DCS 400 classic can be replaced by all or single new PCB's like (SDCS-CON-3A / -PIN-3A / -FIS-3A). The existing field choke (3ADT748069/70) must not replaced by a new field choke type.The DCS 400 Rev. A with the new field choke (3ADT748073/74) expect PCB's with index A only.				

Drive Firmware Update

Hint:

In Lotus Notes database

DC Drives News

DCS 400

Firmware (Free Download)

is always available the **latest** DCS 400 firmware including a detailed description and required PC Tool

D4_1080A.exe

also in Internet

www.abb.com/motors&drives

DC Drives

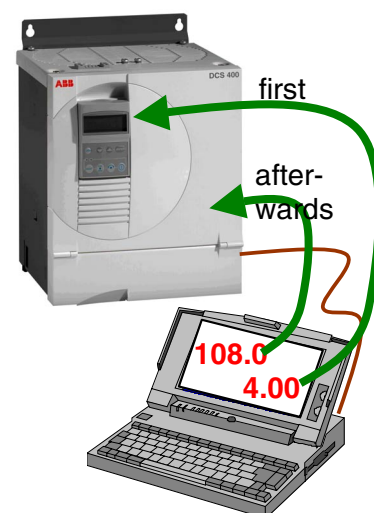
DC 400

Downloads

Drive software

Replace Firmware 107.3 (or earlier) to 108.0 on an existing SDCS-CON-3 board

- Starting situation:
 - **DCS 400 „classic“** with firmware **107.3** (or earlier).
 - Operating panel **DCS400PAN** with text version **3.00** (or earlier).
 - **Attention:** Parameter stored in operating panel will be lost!
- Requirements:
 - PC incl. Drive Window Light
 - PC tool **D4_1080A.exe**
- Connect PC to DCS 400.
Start Drive Window Light.
Upload parameter from drive to PC and save to harddisk.
- Switch off electronics.
Set jumper **S4: 3-4** to **1-2**.
Switch on electronics.
- Load panel text file **4.00** into the drive using "Flash" PC tool.
- Switch off electronics.
Set jumper **S4: 1-2** to **3-4**.
Switch on electronics.
- Update the operating panel.
- Switch off electronics.
Set jumper **S4: 3-4** to **1-2**.
Switch on electronics.
- Load firmware **108.0** into the drive using "Flash" PC tool.
- Switch off electronics.
Set jumper **S4: 1-2** to **3-4**.
Switch on electronics

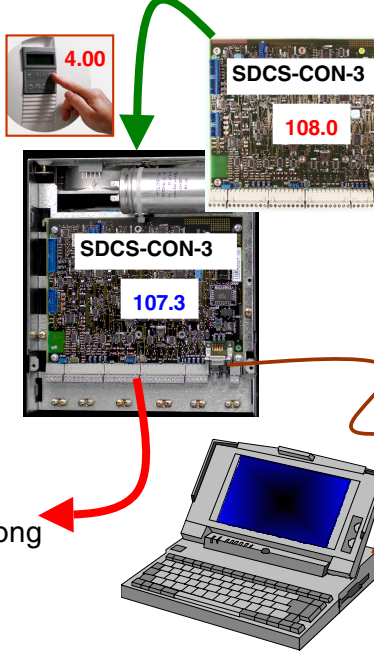


Hint:

Do the panel update
before firmware update

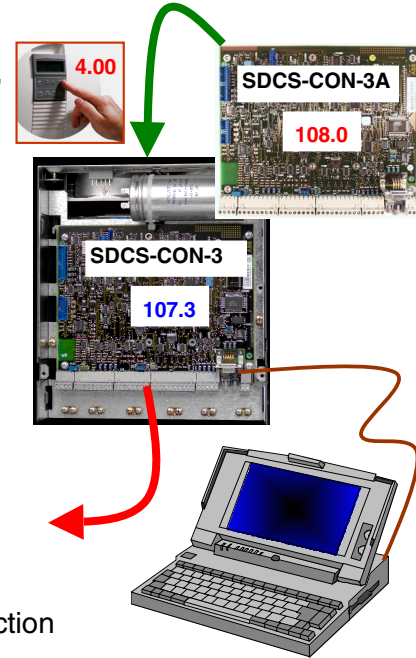
- Ignore possible faults to begin.
Check software version:
 - Parameter **SW Version (7.04) = 108.0**
Pan Text Vers (7.19) = 4.00.
 - Maybe it's necessary to select long parameter list in panel function **Long/Short Par List**.
- Select panel function **Set Typecode**, see *DCS 400 Manual page 6-4*.
Pin number is **400**.
 - Read **Type** from converter name plate (e.g. **DCS401.0045**).
 - Select type in the list and confirm.
 - Confirm converter type and wait 10 s.
 - Switch off and on electronics.
- Download parameter from harddisk into the drive using Drive Window Light.
- Upload parameter into the operating panel, see *DCS 400 Manual page 6-5*.
- Check the behavior of the drive.
- New parameter and signals in firmware 108.0:
 - Arm Curr Lev (3.25)**
 - Ramp In Act (5.33)**
 - Tacho Offset (5.34)**
 - CON-Board (7.21)**
 - Disable Bridge 1 (9.19)**
 - Disable Bridge 2 (9.20)**

Replace SDCS-CON-3 with firmware 107.x by SDCS-CON-3 with firmware 108.0

- Starting situation:
 - **DCS 400** with firmware **107.3** (or earlier).
 - Operating panel **DCS400PAN** with text version **3.00** (or earlier).
 - New controller board **SDCS-CON-3** incl. firmware **108.0**
 - New operating panel **DCS400PAN** with text version **4.00**
- Connect operating panel **DCS400PAN** version **4.00** to the converter.
Upload parameter into the panel.
 
- Switch off electronics.
Replace controller board by the new one.
Switch on electronics.
- Ignore possible faults to begin.
Check software version:
 - Parameter
SW Version (7.04) = 108.0
Pan Text Vers (7.19) = 4.00
 - Maybe it's necessary to select long parameter list in panel function **Long/Short Par List**.
- Select panel function **Set Typecode**, see *DCS 400 Manual* page 6-4.
Pin number is **400**.
 - Read **Type** from converter name plate (e.g. **DCS401.0045**).
 - Select type in the list and confirm.
 - Confirm converter type and wait 10 sec.
 - Switch off and on electronics.
- Download parameter from panel into the drive.
- Do the commissioning:
 - if analogue tacho is used adjust potentiometer **R115**.
 - if encoder is used correct **Jumper S2**.
- Check the behavior of the drive.
- New parameter and signals in firmware 108.0:
 - Arm Curr Lev (3.25)**
 - Ramp In Act (5.33)**
 - Tacho Offset (5.34)**
 - CON-Board (7.21)**
 - Disable Bridge 1 (9.19)**
 - Disable Bridge 2 (9.20)**

Replace SDCS-CON-3 by SDCS-CON-3A

- Requirements:
 - **SDCS-CON-3A** with firmware **108.0**
 - Operating panel **DCS400PAN** with text version **4.00**.
- Connect operating panel (version 4.00) to the converter. Upload parameter into the panel, see *DCS 400 manual* page 6-5.
- Switch off electronics. Replace **SDCS-CON-3** by **SDCS-CON-3A**. Connect operating panel to the updated converter.
- Switch on electronics. Ignore possible faults to begin. Check software version:
 - Parameter
SW Version (7.04) = 108.0
Pan Text Vers (7.19) = 4.00.
 - Maybe it's necessary to select long parameter list in panel function **Long/Short Par List**.
- Select panel function **Set Typecode**, see *DCS 400 manual* page 6-4.
Pin number is **400**.
 - Read **Type** from converter name plate (e.g. **DCS401.0045**).
 - Select type in the list and confirm.
 - Select Revision **without** and confirm.
 - Confirm converter type and wait 10 sec.
 - Switch off and on electronics.
- Download parameter from panel into the drive.
- Do the commissioning:
 - if analogue tacho is used adjust potentiometer **R115**.
 - if encoder is used correct **Jumper S2**.
- New parameter and signals in firmware 108.0:
 - Arm Curr Lev (3.25)**
 - Ramp In Act (5.33)**
 - Tacho Offset (5.34)**
 - CON-Board (7.21)**
 - Disable Bridge 1 (9.19)**
 - Disable Bridge 2 (9.20)**



Replace SDCS-CON-3A by SDCS-CON-3A

- Requirements:
 - **SDCS-CON-3A** with firmware **108.0**
 - Operating panel **DCS400PAN** with text version **4.00**.
- Connect operating panel (version 4.00) to the converter. Upload parameter into the panel, see *DCS 400 manual* page 6-5.
- Switch off electronics. Replace controller board **SDCS-CON-3A** by the new one. Connect operating panel to the converter.
- Switch on electronics. Ignore possible faults to begin. Check software version:
 - Parameter
SW Version (7.04) = 108.0
Pan Text Vers (7.19) = 4.00
 - Maybe it's necessary to select long parameter list in panel function **Long/Short Par List**.
- Select panel function **Set Typecode**, see *DCS 400 manual* page 6-4.
 Pin number is **400**.
 - Read **Type** from converter name plate (e.g. **DCS401.0045**).
 - Select type in the list and confirm.
 - Select Revision **Rev.A.1** and confirm.
 - Confirm converter type and wait 10 sec.
 - Switch off and on electronics.
- Download parameter from panel into the drive.
- Do the commissioning:
 - if analogue tachometer is used adjust potentiometer **R115**.
 - if encoder is used correct **Jumper S2**.

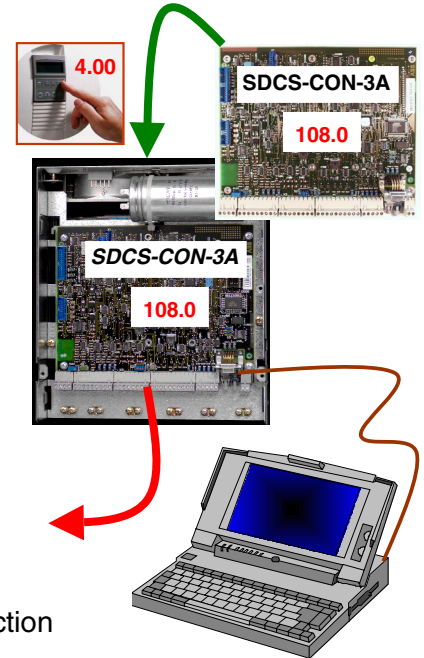




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